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COINCIDENCES AND SUPERSTITIONS.

BY R. A. PROCTOR.

EVERY one is familiar with the occasional occurrence of coincidences, so strange—considered abstractly—that it appears difficult to regard them as due to mere casualty. The mind is dwelling on some person or event, and suddenly a circumstance happens which is associated in some altogether unexpected, and as it were improbable, manner with that person or event. A scheme has been devised which can only fail if some utterly unlikely series of events should occur, and precisely those events take place. Sometimes a coincidence is utterly trivial, yet attracts attention by the singular improbability of the observed events. We are thinking of some circumstance, let us say, in which two or three persons are concerned, and the first book or paper we turn to shows, in the very first line we look at, the names of those very persons, though really relating to others in no way connected with them; and so on, with many other kinds of coincidence, equally trivial and equally singular. Yet again, there are other coincidences which are rendered striking by their frequent recurrence. It is to such recurring coincidences that common superstitions owe their origin, while the special superstitions thus arising (that is, superstitions entertained by individuals) are innumerable. It is lucky to do this, unlucky to do that, say those who believe in common superstitions; and they can always cite many coincidences in favour of their opinion. But it is amazing how common are the private superstitions entertained by many who smile at the superstitions of the ignorant; we must suppose that all such superstitions have been based upon observed coincidences. Again, there are tricks or habits which have obviously had their origin in private superstitions. Dr. Johnson may not have believed that some misfortune would happen to him if he failed to place his hand on every post which he passed along a certain route; he would certainly not have maintained such an opinion publicly; yet in the first instance that habit of his must have had its origin in some observed coincidences; and when once a habit of the sort is associated with the idea of good luck, even the strongest minds have been found unready to shake off the superstition.

It is to be noticed, indeed, that many who reject the idea that the ordinary superstitions have any real significance, are nevertheless unwilling to run directly counter to them. Thus, a man shall be altogether sceptical as to the evil effects which follow, according to a common superstition, from passing under a ladder; he may be perfectly satisfied that the proper reason for not passing under a ladder is the possibility of its falling, or of something falling from it; yet he will not pass under a ladder, even though it is well secured, and obviously carries nothing which can fall upon him. So with the old superstition that a broken mirror brings seven years of sorrow, which, according to some, dates from the time when a mirror was so costly as to represent seven years' savings—there are those who despise the superstition who would yet be unwilling to tempt fate (as they put it) by wilfully breaking even the most worthless old looking-glass. A story is not unfrequently quoted in defence of such caution. Every one knows that sailors consider it unlucky for a ship to sail on a Friday. A person anxious to destroy this superstition, had a ship's keel laid on a Friday, the ship launched on a Friday, her masts taken in from the sheer-hulk on a Friday, the cargo shipped on a Friday; he found (Heaven knows how, but so the story runs) a Captain Friday to command her; and, lastly, she sailed on a Friday. But the superstition was not destroyed, for the ship never returned to port, nor was the manner of her destruction known. Other instances of the kind might be cited. Thus a feeling is entertained by many persons not otherwise superstitious that bad luck will follow any wilful attempt to run counter to a superstition.

It is somewhat singular that attempts to correct even the more degrading forms of superstition have often been as unsuccessful as those attempts which may perhaps not unfairly be called tempting fate. Let me be understood. To refer to the example already given, it is a manifest absurdity to suppose that the sailing of a ship on a Friday is unfortunate; and it would be a piece of egregious folly to consider such a superstition when one has occasion to take a journey. But the case is different when any one undertakes to *prove* that the superstition is an absurdity; simply because he must assume in the first instance that he will succeed, a result which cannot be certain; and such confidence, apart from all question of superstition, is a mistake. In fact, a person so acting errs in the very same way as those whom he wishes to correct; *they* refrain from a certain act because of a blind fear of bad luck, and *he* proceeds to the act with an equally blind belief in good luck.

But one cannot recognise the same objection in the case of a person who tries to correct some superstition by actions not involving any tempting of fortune. Yet it has not unfrequently happened that such actions have resulted in confirming the superstition. The following instance may be cited. An old woman came to Flamsteed, the first Astronomer Royal, to ask him whereabouts a certain bundle of linen might be, which she had lost. Flamsteed determined to show the folly of that belief in astrology which had led her to Greenwich Observatory (under some misapprehension as to the duties of an Astronomer Royal). He "drew a circle, put a square into it, and gravely pointed out a ditch, near her cottage, in which he said it would be found." He then waited until she should come back disappointed, and in a fit frame of mind to receive the rebuke he intended for her; "but she came back in great delight, with the bundle in her hand, found in the very place."

In connection with this story, though bearing rather on over-hasty scientific theorising than on ordinary superstitions, I quote the following story from De Morgan's "Budget of Paradoxes":—"The late Baron Zach received

a letter from Pons, a successful finder of comets, complaining that for a certain period he had found no comets, though he had searched diligently. Zach, a man of much sly humour, told him that no spots had been seen on the sun for about the same time—which was true—and assured him that when the spots came back the comets would come with them. Some time after he got a letter from Pons, who informed him with great satisfaction that he was quite right; that very large spots had appeared on the sun, and that he had found a comet shortly after. I have the story in Zach's handwriting. It would mend the story exceedingly if some day a real relation should be established between comets and solar spots. Of late years good reason has been shown for advancing a connection between these spots and the earth's magnetism. If the two things had been put to Zach, he would probably have chosen the comets. Here is a hint for a paradox: The solar spots are the dead comets, which have parted with their light and heat to feed the sun, as was once suggested. I should not wonder if I were too late, and the thing had been actually maintained." De Morgan was not far wrong. Something very like his paradox was advocated, before the Royal Astronomical Society, by Commander Ashe, of Canada, earlier, we believe, than the date of De Morgan's remarks. I happen to have striking evidence in favour of De Morgan's opinion about the view which Zach would probably have formed of the theory which connects sun-spots and the earth's magnetism. When the theory was as yet quite new, I referred to it in a company of Cambridge men, mostly high mathematicians, and it was received at first as an excellent joke, and welcomed with laughter. It need hardly be said, however, that when the nature of the evidence was stated, the matter assumed another aspect. Yet it may be mentioned, in passing, that there are those who maintain that, after all, this theory is untrue, the evidence on which it rests being due only to certain strange coincidences.

In many instances, indeed, considerable care is required to determine whether real association or mere casual coincidence is in question. It is surprising how, in some cases, an association can be traced between events seemingly in no way connected. One is reminded of certain cases of derivation. Ninety-nine persons out of a hundred, for instance, would laugh at the notion that the words "hand" and "prize" are connected; yet the connection is seen clearly enough when "prize" is traced back to "prehendo," with the root "hend" obviously related to "hand," "hound," and so on. Equally absurd at a first view is the old joke that the Goodwin Sands were due to the building of a certain church; yet, if moneys which had been devoted to the annual removal of the gathering sand were employed to defray the cost of the church, mischief, afterwards irreparable, might very well have been occasioned. Even the explanation of certain mischances as due to the circumstance that "there was no weathercock at Kiloe," may admit of a not quite unreasonable interpretation. I leave this as an exercise for the ingenious reader.

(To be continued.)

THE CHEMISTRY OF COOKERY.

XXXI.

By W. Mattieu Williams.

HAVING described the changes effected by heat upon starch, and referred to its further conversion into dextrine and sugar, I will now take some practical examples of the cookery of starch foods, beginning with those which are composed of pure, or nearly pure, starch.

When arrowroot is merely stirred in cold water it sinks to the bottom undissolved and unaltered. When cooked in the usual manner to form the well-known mucilaginous or jelly-like food, the change is a simple case of the swelling and breaking up of the granules described as occurring in water at the temperature of 140° Fahr. There appears to be no reason for limiting the temperature, as the same action takes place from 140° upwards, to the boiling point of water.

I may here mention a peculiarity of another form of nearly pure starch food, viz., tapioca, which is obtained by pulping and washing out the starch granules of the root of the *Manihot*, then heating the washed starch in pans and stirring it while hot with iron or wooden paddles. This cooks and breaks up the granules and agglutinates the starch into nodules which, as Mr. James Collins explains (*Journal of Society of Arts*, March 14, 1884,) are thereby coated with dextrine, to which gummy coating some of the peculiarities of tapioca pudding are attributable. It is a curious fact that this *Manihot* root, from which our harmless tapioca is obtained, is terribly poisonous. The plant is one of the large family of nauseous spurgeworts (*Euphorbiaceæ*). The poison resides in the milky juice surrounding the starch granules, but being both soluble in water and volatile, most of it is washed away in separating the starch granules, and any that remains after washing is driven off by the heating and stirring which has to reach 240°, in order to effect the changes above described.

I suspect that the difference between the forms of tapioca and arrowroot has arisen from the necessity of thus driving off the last traces of the poison with which the aboriginal manufacturers were so well acquainted as to combine the industry of poisoning their arrows with that of extracting the starch-food from the same root. No certificate from the public analyst is demanded to establish the absence of the poison from any given sample of tapioca, as the juice of the manihot root, like that of other spurges, is unmistakably acrid and nauseous.

Sago, which is a starch obtained from the pith of the stem of the sago-palm and other plants, is prepared in grains like tapioca, with similar results. Both sago and tapioca contain a little gluten, and therefore have more food-value than arrowroot.

The most familiar of our starch foods is the potato. I place it among the starch foods, as next to water, starch is its prevailing constituent, as the following statement of average compositions will show:—Water, 75 per cent.; starch, 18·8; nitrogenous materials, 2; sugar, 3; fat, 0·2; salts, 1. The salts vary considerably with the kind and age of the potato, from 0·8 to 1·3 in full-grown. Young potatoes contain more. In boiling potatoes, the change effected appears to be simply a breaking up or bursting of the starch granules, and a conversion of the nitrogenous gluten into a more soluble form, probably by a certain degree of hydration. As we all know, there are great differences among potatoes, some are waxy, others floury; and these, again, vary according to the manner and degree of cooking. I cannot find any published account of the chemistry of these differences, and must, therefore, endeavour to explain them in my own way.

As an experiment, take two potatoes of the floury kind; boil or steam them together until they are just softened throughout, or, as we say, "well done." Now leave one of them in the saucepan or steamer, and very much overcook it. Its floury character will have disappeared, it will have become soft and gummy. The reader can explain

this by simply remembering what has already been explained concerning the formation of dextrine. It is due to the conversion of some of the starch into dextrine. My explanation of the difference between the waxy and floury potato is that the latter is so constituted that all the starch granules may be disintegrated by heat in the manner already described before any considerable proportion of the starch is converted into dextrine, while the starch of the waxy potatoes for some reason, probably a larger supply of diastase, is so much more readily convertible into dextrine, that a considerable proportion becomes gummy before the whole of the granules are broken up, *i.e.*, before the potato is cooked or softened throughout.

I must here throw myself into the great controversy of jackets or no jackets. Should potatoes be peeled before cooking, or should they be boiled in their jackets? I say most decidedly in jackets, and will state my reasons. From 53 to 56 per cent. of the above-stated saline constituents of the potato is potash, and potash is an important constituent of blood—so important that in Norway, where scurvy once prevailed very seriously, it has been banished since the introduction of the potato, and according to Lang and other good authorities, it is owing to the use of this vegetable by a people who formerly were insufficiently supplied with saline vegetable food.

Potash salts are freely soluble in water, and I find that the water in which potatoes have been boiled contains potash, as may be proved by boiling it down to concentrate, then filtering and adding the usual potash test, platinum chloride.

It is evident that the skin of the potato must resist this passage of the potash into the water, though it may not fully prevent it. The bursting of the skin only occurs at quite the latter stage of the cookery. The greatest practical authorities on the potato, Irishmen, appear to be unanimous. I do not remember to have seen a pre-peeled potato in Ireland. I find that I can at once detect by the difference of flavour whether a potato has been boiled with or without its jacket, and this difference is evidently saline.

These considerations lead to another conclusion, viz., that baked potatoes, and fried potatoes, or potatoes cooked in such a manner so as to be eaten with their own broth, as in Irish stew (in which cases the previous peeling does no mischief), are preferable to boiled potatoes. Steamed potatoes probably lose less of their potash juices than when boiled; but this is uncertain, as the modicum of distilled water condensed upon the potato and continually renewed may wash away as much as the larger quantity of hard water in which the boiled potato is immersed.

Those who eat an abundance of fruit, of raw salads, and other vegetables supplying a sufficiency of potash to the blood, may peel and boil their potatoes; but the poor Irish peasant who depends upon the potato for all his sustenance requires that they shall supply him with potash.

When travelling in Ireland (I explored that country rather exhaustively when editing the Fourth Edition of "Murray's Handbook), I was surprised at the absence of fruit-trees in the small farms where one might expect them to abound. On speaking of this the reason given was that all trees are the landlord's property; that if a tenant should plant them they would suggest luxury and prosperity, and therefore a rise of rent; or otherwise stated, the tenant would be fined for thus improving the value of his holding. This was before the passing of the Land Act, which we may hope will put an end to such legalised brigandage. With the abolition of rack-renting the Irish peasant may grow and eat fruit; may even taste jam without fear and trembling; may grow rhubarb and make pies and puddings in defiance of the agent. When this is the case, his craving for potato-potash will probably diminish, and his children may actually feed on bread.

As regards the nutritive value of the potato, it is well to understand that the common notion concerning its cheapness as an article of food is a fallacy. Taking Dr. Edward Smith's figures, 760 grains of carbon and 24 grains of nitrogen are contained in 1 lb. of potatoes; 2½ lb. of potatoes are required to supply the amount of carbon contained in 1 lb. of bread; and 3½ lb. of potatoes are necessary for supplying the nitrogen of 1 lb. of bread. With bread at 1½d. per lb., potatoes should cost less than ½d. per lb. in order to be as cheap as bread for the hard-working man who requires an abundance of nitrogenous food.

My own observations in Ireland have fully convinced me of the wisdom of William Cobbett's denunciation of the potato as a staple article of food. The bulk that has to be eaten, and is eaten, in order to sustain life, converts the potato feeder into a mere assimilating machine during a large part of the day, and renders him unfit for any kind of vigorous mental or bodily exertion. If I were the autocratic Czar of Ireland my first step towards the regeneration of the Irish people would be the introduction, acclimatising, and dissemination of the Colorado beetle, in order to produce a complete and permanent potato famine. The effect of potato feeding may be studied by watching the work of a potato-fed Irish mower or reaper who comes across to work upon an English farm where the harvestmen are fed in the farmhouse and the supply of beer is not excessive. The improvement of his working powers after two or three weeks of English feeding is comparable to that of a horse when fed upon corn, beans, and hay, after feeding for a year on grass only.

The reader may have observed that the starch foods already described are all derived from the roots or stems of plants. Many others might be named that are used in tropical climates where little labour is demanded or done, and but little nitrogenous food required. Having treated the cookery of the chief constituents of these parts of the plant, the fibre and the starch, I now come to food obtained from the seeds and the leaves.

Taking the seeds first, as the more important, it becomes necessary to describe the nitrogenous constituents which are more abundant in them than in any other part of the plant, though they also contain the starch and cell material, or woody fibre, as already stated.

In No. 29 of this series, page 123, I described a method of separating starch from flour by washing a piece of dough in water, and thereby removing the starch granules, which fall to the bottom of the water. If this washing is continued until no further milkiness of the water is produced, the piece of dough will be much reduced in dimensions, and changed into a grey, tough, elastic, and viscous or glutinous substance, which has been compared to bird-lime, and has received the appropriate name of *gluten*. When dried, it becomes a hard, horny, transparent mass. It is insoluble in cold water, and partly soluble in hot water. It is soluble in strong vinegar, and in weak solutions of potash or soda. If the alkaline solution is neutralised by an acid, the gluten is precipitated.

If crude gluten obtained as above is subjected to the action of hot alcohol, it is separated into two distinct substances, one soluble and the other insoluble. As the solution cools, a further separation takes place of a substance soluble in hot alcohol but not in cold, and another soluble in either hot or cold alcohol. The first—viz., that insoluble in either hot or cold alcohol has been named *gluten-fibrin*; that soluble in hot alcohol, but not in cold, *gluten-casein*; and that soluble in either hot or cold alcohol, *glutin*. I

give these names and explain them, as my readers may be otherwise puzzled by meeting them in books where they are used without explanation, especially as there is another substance presently to be described, to which the name of vegetable casein has also been applied. The gluten-fibrin is supposed to correspond with blood fibrin, gluten-casein with animal casein, and glutin with albumen.

EFFECTS OF THE GLACIAL PERIOD.

I.—INORGANIC EFFECTS.

WHEN we dealt with the "Evidences of the Glacial Period," we enumerated, under the head of "Inorganic Evidences," moraines, polished and striated rock surfaces, erratic blocks, perched boulders, scored and rounded mountains, and dome-shaped rocks. Of course, all these might, with equal propriety, be treated as Effects of the Glacial Period; but, having already briefly described them, I do not purpose to make any further comment thereon now, with the single exception of observing that probably the most striking of such effects may be seen in the rounded mountain summits of Scotland, Wales, and the Lake District. No evidence or effect of the Glacial Period can be more obvious to the ordinary eye, not specially trained in the observation of geological scenery, than these widely distributed and boldly rounded mountain summits.

In addition to the marks in the scenery of the country already enumerated, may be mentioned, as a similar effect of the Glacial Period, the formation of that mass of unstratified *débris* known as the *Boulder Clay*. This Boulder Clay is a mixture of all kinds of rock material, including fragments of all sizes and shapes (many being angular, and polished and striated by the action of ice) imbedded in earth composed in different districts of different materials. For some time the origin of this mass of heterogeneous *débris* was much disputed; but now all the most eminent geologists agree in regarding it as an accumulation formed chiefly under a great ice sheet which once enveloped the whole of the British Isles. Accumulations of *débris* on a very much smaller scale are formed underneath existing glaciers, and have received from the French geologists the name of *moraines profondes;* but owing to the Boulder Clay being so extensively distributed throughout Great Britain, and occurring in such large quantities (the district of Holderness, in Yorkshire, is formed entirely of it), it is considered that the British Boulder Clay forms the vast effect of a mighty power of erosion which was once exerted upon the whole country by an ice sheet which entirely buried it, and ploughed up the surface of the land, grinding and mixing together into a mass of confused rubbish the materials of which such surface was composed. A fact which is confirmatory of this explanation of the origin of Boulder Clay is that that formation, wherever found, consists chiefly of fragments of the neighbouring rocks. For example, in the neighbourhood of the chalk we have the "Great Chalky Boulder Clay," which is absent from districts remote from the chalk; in the neighbourhood of the Lias the Boulder Clay teems with worn fossils derived from that formation, and in like manner elsewhere, the great glacial sheet having in every case formed its *débris* of the materials over which it passed.

A very important, and at the same time very interesting, effect of the Glacial Period, is the great part that period took in the formation of numerous *lakes*. To Professor Ramsey is due the credit of having first discovered the interesting connection between the marks of glacial action found so widely distributed in the north temperate zone and the occurrence of a great number of lakes in that part of the globe. When we look at the map of the world we cannot fail to be struck by the remarkable number of lakes found in all those regions where evidences of ice action are found. In the American continent we find the whole territory of British North America (a region containing abundant evidences of a former glacial condition) covered with lakes too numerous to count. In the British Isles, where, as we have seen, the Glacial Period left such striking marks upon the scenery of the country, we find Scotland, Wales, and the north of England (all severely glaciated districts) teeming with lakes, while the similar regions of Switzerland, Scandinavia, and Finland furnish a no less remarkable number. The occurrence of such a great number of lakes in regions bearing such evident marks of glacial action could not be without meaning, and Professor Ramsay was led by the remarkable coincidence of the two phenomena to ascribe both to the same cause, and so to formulate a theory of the origin of a large class of lakes by the eroding power of glaciers. Taking the Lake of Geneva as an object of special study, he was brought, by a due appreciation of the great grinding power which a moving mass of ice 4,000 ft. or 5,000 ft. in thickness (with its numerous imbedded sharp and angular stones) must necessarily have exerted upon underlying rocks of soft material, to consider a large number of lakes found in countries bearing marks of glacial action, as the effects of the Glacial Period. As facts confirmatory of this theory, it may be noted that nearly all such lakes occur in the lines of old glaciers, and that in a great number of them the rock basin of the lake is much deeper than the outlet channel, a fact which entirely precludes their formation by running water, and is only explicable by the greater eroding power of a glacier when of great thickness that when, lower in its course, it gradually becomes thinner as it approaches the melting point. Very many lakes in the regions we have mentioned lie in rock basins of this form, and it is easy to see that such form is just what we might expect to result from the grinding power exerted upon the underlying rocks by a descending glacier; such power being greatest where the ice was thickest, and where its pressure was most nearly vertical.

But it is very interesting to know that rock basins of this form occur on the coasts of countries once exposed to ice action *beneath the sea-level*, and are then known as *fiords* or *lochs*, the characteristic features of which are that they are shallower at their entrances than further up, the inland recesses of the fiord being generally much deeper than the mouth. As this construction is identical with the construction of that class of lakes we have been considering it becomes obvious that fiords are simply rock-bound, glacial-formed lakes, the outlets of which, having become submerged, have admitted the waters of the sea. These fiords or lochs form a grand and beautiful characteristic of the scenery of Norway and Scotland, two countries in which, perhaps, the effects of the Glacial Period have been greater than anywhere else.

Although the great majority of lakes due to glacial action in the north temperate zone lie in *deep rock basins*, and were probably formed by the *scooping out* power of glaciers, some few lakes in that region, also the effect of the Glacial Period, have been caused by the *damming up of valleys by terminal moraines*. Such lakes, however, are generally small, and are often known as *tarns*. They occur plentifully among the mountains of Wales and the Italian Alps.

Lakes, or rather ponds, of another class which may also be included indirectly in the Effects of the Glacial Period, have been formed in hollows or *inequalities in the boulder clay*. Examples of such ponds are easy to find in Yorkshire or anywhere else where boulder clay exists in any considerable quantity. Being generally shallow, they have a great tendency to get filled up with vegetation and become converted into peat mosses or bogs.

The Glacial Period has also played an important part in the formation and modification of *valleys*. It is easy to see how, in districts where the rocks are composed of very soft material, great hollows or valleys might be scooped out by the eroding power of glaciers, and to this agency has been attributed the formation of the beautiful dales of Yorkshire and other valleys. But, generally speaking, the effect of the Glacial Period with regard to valleys has been more to modify and deepen than to form them, as in all probability the principal valleys were formed before the Glacial Period, and then determined the flow of the glaciers, which have, in almost every case, considerably modified them, and left indisputable marks of an Ice Age in the northern part of the world.

It has been thought, not without some degree of plausibility, that one of the most immediate effects of the Glacial Period would be the *occurrence of great floods* and the *submergence of large tracts of land*, as the glacial condition of things approached its termination. For it has been calculated that during the Glacial Period such vast masses of water would be locked up as snow and ice, that the average level of the sea must have been at least 1,000 feet lower than at present. This would cause considerable tracts of land to be laid bare, which, as the ice melted and the average level of the ocean rose, would be subjected to floods, and ultimately to submergence. This supposition receives support from the great number of traditions current among mankind concerning floods, and also concerning the former existence of countries now submerged. Such traditions are not without their value, for it is now an acknowledged fact that man existed during the Glacial Period (the discovery of his tools and implements in glacial formations having settled the question), and, such being the case, it is only reasonable for us to expect to find in his descendants dim traditions of those great events and changes which must have occurred towards the close of that period, and of which he was doubtless an interested spectator.

We have now dealt with what may be arranged under the head—Inorganic Effects of the Glacial Period. In our next article we propose to consider the Organic Effects of the same.

ROBERT B. COOK.

URANUS AND NEPTUNE IN A THREE-INCH TELESCOPE.

BY A FELLOW OF THE ROYAL ASTRONOMICAL SOCIETY.

IN one sense this series of essays would be incomplete were no reference made in them to the aspect in our instrument of the (as far as is at present known) two outermost members of our solar system. A three-inch telescope is hardly the one which the observer would select for the scrutiny of these dim and distant orbs: but, if we are to view them at all, we must employ the optical means at our disposal, and make the most of what we possess. As will be seen from the Zodiacal Map on p. 165, Uranus is now coming into a favourable position for examination. He is so close to β Virginis as to be well within a tolerably low power field together with that star. Even with a power that will include the star and the planet in the same field a very notable difference in their aspect is perceptible; but we must use all the magnification that our telescope will admit of to see Uranus to the greatest advantage; and under such a power he was absolutely isolated in the field of view when the subjoined drawing was made.

Uranus, March 16, 1884, 9h. 15m. G.M.T., power 250.

It will be seen that the planet exhibits the appearance of a small greyish-blue disc, seemingly perfectly uniform in tint and without markings of any kind. That the disc, however, is planetary and not stellar is evident enough with the power we are using, and may be rendered even more apparent by turning the telescope on to β Virginis, and comparing the two images. The difference between the pale diffused disc of Uranus and the sharp and brilliant one of the star, with its single diffraction ring (wholly wanting, of course, in the former,) will instantly strike the eye. That, however, much more will even be found out as to the physical aspect of the planet, is—in the existing state of practical optics—doubtful. Light itself, travelling at the rate of nearly 187,000 miles in a second, takes more than 2 hours and 28 minutes to pass across the stupendous interval which separates us from this remote world when he is in opposition to the sun. The student will have read that Uranus is attended by four satellites; but it is quite needless to add that they are utterly beyond the power of the telescope we are employing. Probably no human eye, save one, has ever seen these extremely minute objects with less than about 7 inches of aperture, the solitary observer to whom we refer being that excellent and almost supernaturally keen-sighted one, Mr. J. W. Ward, of Belfast, who did actually glimpse the two outer satellites with only 4·3 in. of aperture on many occasions during the early part of the year 1876! The reality of this quasi-miraculous feat was placed beyond doubt by the subsequent comparison of Mr. Ward's diagrams made at the telescope, with Mr. Mark's calculated ephemerides of the satellites. Uranus, we may add, is just visible to the naked eye. Of Neptune little need be said. He is at present lost in the glare of the sun's light. He will be well placed next November for the observer in the confines of Aries and Taurus, about 5° south-west of the Pleiades. In a three-inch telescope with a power of 250, he looks something like an eighth magnitude star; but, as in the case of Uranus, he exhibits no diffraction rings and is dimmer than an ordinary fixed star. It, however, requires a large and powerful telescope to exhibit Neptune with an unmistakably planetary disc, and the observer with an instrument of the size of that whose use is pre-supposed in these papers may be contented if he can fairly satisfy himself that it is not a star that he is looking at.

THE production of the Lake Superior copper-mines for 1883 was sixty million pounds of copper.

TELEGRAPH OFFICES IN CANADA.—The total number of telegraph offices in Canada is 2,259, the highest number *pro ratâ* to the population of any country in the world.—*Electrician.*

HOW TO GET STRONG.

(*Continued from page* 159.)

TO STRENGTHEN THE LOIN-MUSCLES.

WE have attended sufficiently to the muscles of the abdomen. The loin-muscles must now have their turn; then the side muscles of the waist.

Probably there is no set of muscles telling more on the strength of the body as a whole than those of the loins, or the muscles in the small of the back along either side of the spine. In nearly every form of exercise these muscles are taxed; so that if they are weak a man cannot do well in rowing, leaping, running, lifting, or any exercises akin to them. But perhaps the most important consideration in connection with these loin-muscles is that at any time we may be called on to use them in such a way that if they are weak they may be strained and perhaps permanently injured. Some one falls in a swoon, perhaps, and must be lifted; but in the effort to lift even the light form of a delicate girl the muscles of the loins, if at all weak, are severely taxed. Or you may be obliged in travelling to haul a heavily-loaded valise into a railway carriage or out of it or across a platform or up steps, no porter being about who will do the work for you. I have known a man apparently strong disabled for four or five days by a strain of the loin-muscles caused by unwonted labour of this sort. On another occasion a friend of mine (who certainly was tolerably weak all round) "ricked his back" as he called it in trying to pull off the top of a wooden case: it is true that in this case the effort would have been futile if his strength had been thrice what it was; but had his loin-muscles been in reasonably good condition he would not have hurt them even by trying to do more than they were equal to. One of the greatest advantages of all training for the muscles, indeed, resides in this, that they as it were learn their own strength, and are not easily persuaded to overtax themselves. Ladies for instance who seldom take pains to strengthen their wrist-muscles, though these are at least as useful to the fair sex as to us of the rougher sort, are much more apt to sprain their wrists in simple every day work than men who are constantly taxing their wrists' strength. Yet men are not commonly troubled with any thought of the fitness of their wrist-muscles to do the work they want from them; they will strain these muscles to their full strength and get no harm. The weaker-wristed carefully refrain from anything likely to tax their wrists, yet quite often make mistakes and get a sprain.

Probably the best steady exercise for the loins is one which most of us have "handy by"—gardening. Digging especially is splendid work for the loins, though trying if they are weak. Best begin with lighter work,—raking, hoeing, dibbling, planting, any work in the garden almost, for nearly all garden work involves leaning over and moving that which one has to stoop more or less to reach. After awhile, digging will not overtax the loins: and then nothing better can be recommended for giving strength to the muscles of the loins and the small of the back, than a good spell with the spade. Not necessarily every day,—once or twice a week will do very well. The exercise may be made interesting by studying floriculture a little; and skill in gardening exercises generally gives by no means slight pleasure. To be able to take an effective turn at digging, hoeing, and so forth, is as pleasant as to be able to pull an efficient oar. It is useful to boot. If there is no garden for flowers, one can nearly always find digging-work which will not be wasted. For instance one can level a piece of ground which had been irregular; or dig out trenches; or make ridges; or otherwise alter the contour of the ground as one may find convenient. Even if nothing is wanted in this way, the strengthening of the loins will be well worth the trouble. Then legs, arms, and wrists gain strength during the work. The chest is not benefited; and would indeed probably suffer in the long run, if such exercise were not counterbalanced by such others as I have already described for developing the upper part of the trunk. This perhaps is the reason why so few care for garden work of the heavier sort: those who get too much of it are always round-shouldered and thin-chested. But almost every exercise is open to a similar objection. Tricycling is not good for the chest, and does harm if uncorrected; yet tricycling is splendid exercise. Rowing is equally harmful alone, yet rowing deserves the esteem in which it is held. So with digging. It is splendid work for the loins, and ninety-nine men out of a hundred want their loins strengthened, and go about at their proper peril with the relatively weak loins they have. Take then this or some kindred exercise, being careful however to get all the good it can give, and avoid any harm, by duly expanding the chest in over-head work.

Failing gardening or like work out of doors, how can the loins be strengthened by indoor exercises? Very readily. *There* is a bedroom chair with a rail half a foot from the ground,—the very thing for loin work. Standing before the chair, its back towards you, lean over (legs straight) and grasp the lowest rail of the back with the right hand. Then raise the chair steadily at arm's length (the hand and wrist getting plenty of work); then steadily lower to the ground, raise, lower, raise again,—until you have had enough. Set the chair down again, square the shoulders, and draw a full breath or two. Now repeat the process, using the left hand instead of the right.

Fill a small hand-bag pretty heavily. Now standing with the legs straight but pretty far apart and the bag just in front of you, raise it with both hands, swing it between the legs, and so soon as it has gone as far back as you find convenient, sway it forwards so as just to clear the ground and continue the sweep upwards till you are holding it out at arms' length in front of you. Lower it (arms straight) steadily till it passes again, just clearing the ground, between your legs; and continue the process till you have had enough to satisfy your loin-muscles for the time. Then, leaving the bag on the ground in front of you, go through some of the chest exercises, drawing long breaths, squaring the shoulders, and striking out to right and left. This arrests any tendency the other exercise may have had to contract the chest. So soon as the loin-muscles are ready again, give them another spell of the bag exercise. That will be enough for one day. And so much work done twice a week or so, will soon make your loin-muscles feel and know their strength. You may not be able, perhaps, as every fairly stalwart man should be, to lift a prostrate person of average weight from the ground (a fainting lady, for instance, or one who has fallen in the way of some vehicle); but at any rate you will no longer be apt to sprain your back in trying. There are in truth however no muscles better worth training (and tuning even to athletic pitch) than the commonly neglected muscles of the lumbar regions.

In the gymnasium, or in any convenient open space, another form of exercise is available and excellent. Set in a row a number of weights,—say each a stone weight to begin with, but you may easily go on till you can substitute 56 lb. weights. Standing at one end of the row, which extends straight in front of you, stoop to the first weight and seizing it with the right hand swing it forward, upward, and over your head, pitching it as far behind you as you

can. Do the like with the second weight, using your left hand and arm instead of the right. Then the third with the right; the fourth with the left; and so forth; till you have Deucalionised the lot. (It is not considered essential that any one should watch this exercise close behind to see that it is correctly done,—in the gymnasium the master, however anxious he may be to see that the exercise is symmetrically accomplished, selects a different position.)

As Mr. Blackie, who is rather silent about specific exercises for the loin-muscles, says, "in many of the heavier grades of manual labour these muscles have a large share of work to do. All stooping over, when lifting is done with a spade, or fork, or bar, whether the knees are held straight or bent, or lifting any weight directly in the hands, horizontal pulling on a pulley-weight rope or oar,—in short, nearly every sort of work where the back is thoroughly employed, keeps these muscles active. You cannot bend over without using them. Weed awhile, and unless already strong in the loins, they will ache."

Among more familiar forms of exercise, cricketing and lawn-tennis may be mentioned as excellent for the loins, though rather by way of limbering the loin-muscles than of adding greatly to their strength, though such exercises do undoubtedly strengthen them too.

Specially for limbering the loin-muscles, the toe-touching exercise common in school drilling is among the best. Every one ought to be able to touch his toes with the fingers without bending the legs; yet very few men can do this comfortably. A few minutes given to dips towards the toes every morning and evening will wonderfully limber the loin-muscles. Don't strain; the power to dip to the toes themselves, or even (as I find my boys can easily manage) to touch the ground with the knuckles or with the palm of the hand, will come gradually. Every day you advance a little. But straining does harm. Just keep steadily dipping, each time just so far as the loins allow you to go, and you will find after awhile the power to dip to the toes will come. To measure your rate of progress in this direction, you may set a book or two on the ground, which you can just dip to,—then day after day put thinner books, until at last you will (probably) be able to dip to the ground without inconvenience.

So may the loin-muscles, strengthened by the former exercises, be rendered limber and elastic.

(To be continued.)

ELECTRO-PLATING.

II.

BY W. SLINGO.

IN the first article of this series (KNOWLEDGE, No. 124) it was remarked that experiment has demonstrated it to be a fact that when a current passes through a liquid containing metals in solution the metallic compound is split up more or less completely into its constituents, and the metal deposited or separated at the negative pole or electrode—that is to say, at the electrode in connection with the zinc or negative pole of the battery. Leaving for a time the separation of hydrogen (which, by the way, possesses many attributes, both chemical and electrical, characteristic of the metals), let us direct our attention to the deposition of copper.

There are several soluble compounds of copper, of which, however, two only need claim attention. Chloride of copper ($CuCl_2$) is an easily soluble compound, each molecule or particle of which contains one volumetric equivalent of copper (Cu) to two of chlorine (Cl), as indicated by the symbol. If two platinum electrodes be connected to the poles of a battery and immersed in a solution of the salt* a current passes through it which separates the chloride into its constituents, the copper being deposited as a fine metallic film on the negative platinum, while the chlorine, which is electrically separated at the positive electrode, enters into combination with it if it be a metal, and forms a chloride of that metal. Thus in the case of platinum, chloride of platinum would result, chloride of zinc or iron being formed if either of those metals are employed. The great cost of platinum is a sufficient cause to preclude the use of it for such a purpose. Iron and zinc are, however, cheap; but their use is not permissible, because their chlorides would enter into solution and impurify it. Carbon is not assailed by chlorine, but even the use of carbon is not commendable, because the solution becomes weaker as the separation of the salt goes on, unless a reservoir is provided to maintain the strength of the electrolyte (a term introduced by Faraday as a distinguishing name for any solution undergoing electrical decomposition). Furthermore, the carbon becomes partially enveloped in a film of chlorine gas, which, however, in time decomposes the water, forming hydrochloric acid, by combining with its hydrogen, and setting free its oxygen. If the positive electrode be of copper, the freed chlorine combines with it, and produces fresh quantities of chloride of copper. It is evident that if two atoms of chlorine combine with one of copper to form a molecule or particle of the chloride, the decomposition of the molecule must result in the deposition of one atom of copper and the freeing of two atoms of chlorine, which, combining with its equivalent (one atom) of copper at the positive electrode, forms a new molecule of the salt. Thus for every molecule decomposed a new one is formed, and the strength of the solution kept constant. It is eminently essential that this constancy should be ensured if a regular or continued deposit is desired.

The other salt of copper to which reference is necessary is the sulphate (SO_4Cu), or the salt which on the substitution of hydrogen for its copper becomes sulphuric acid (SO_4H_2). If two strips of platinum in connection with the poles of a battery be immersed in a solution of this salt it is decomposed by the current—copper, as before, being deposited on the negative plate, while the other portion of the molecule (SO_4) is disengaged at the positive electrode. SO_4, which has been called sulphion, is, however, incapable of a separate existence, and as it is unable to assail the platinum it decomposes a molecule of water (OH_2), and combines with the hydrogen to form a molecule of sulphuric acid, the oxygen escaping into the air as a gas. The same thing happens if carbon be substituted for platinum, but copper being assailable, the substitution of that metal for the positive platinum serves, as in the case of chloride of copper, to maintain the strength of the solution—one atom of copper being dissolved from the positive plate for every atom deposited on the negative plate.

An important question now presents itself. What relation does the amount of solution affected, or of metal deposited, bear to the current? A reference to the articles on Electrical Measurement, which appeared in the second volume of KNOWLEDGE, will demonstrate the fact that the current passing through a circuit depends directly upon its

* A salt is a compound which results from the action of an acid upon a metal, or which becomes an acid by hydrogen being substituted for the metal. Thus $CuCl_2$ is a salt resulting from the action of hydrochloric acid (HCl) on copper, hydrogen being set free in the process. It is manifest that if the copper be displaced by hydrogen hydrochloric acid (frequently called muriatic acid) would again be formed. Of this we shall see more later on, but the recollection of the definition of a salt is essential.

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electro-motive force (which may be rudely described as the power the current possesses to overcome resistance or obstacles presented to its passage) and inversely upon the total amount of resistance in the circuit. In other words, if we double the electro-motive force (E M F), the resistance remaining constant, or if we halve the resistance while the E M F remains constant, we in each case double the current. Thus, if we have a current of an E M F of 2 volts,* and cause it to traverse a circuit of 2 ohms† resistance we shall get a current of $\frac{2 \text{ volts}}{2 \text{ ohms}} = 1$ ampère.‡ Doubling the E M F in one case, and halving the resistance in the other, we get the same result thus :—

$$\frac{4 \text{ volts}}{2 \text{ ohms}} = \frac{2 \text{ volts}}{1 \text{ ohm}} = 2 \text{ ampères.}$$

Roughly, to increase the E M F, we increase the number of cells, and, to reduce the resistance, we increase the size of the cells or shorten the length of wire connecting the pole of the battery. These points are thus briefly touched upon here because a consideration of them will be involved later on.

It does not require much mental exertion to see that if we have a gas or water-pipe of varying section, the quantity of gas or water passing each and every point in a given time will be identical, providing there be no intermediate outlets. Similarly, if we join up an electrical circuit, the amount of current passing each point of the circuit in a given time will be equal; in other words, the strength of the current is the same in all parts of the circuit. The sequence is that if we have fifty similar decomposition (or electrolytic) cells in circuit with a battery of commensurate proportions, the amount of metal deposited will be the same in each cell. It does not follow, however, that the same battery-power which will deposit a grain of copper in one cell will deposit a similar quantity in each of fifty cells, else we should be a long way on the road to perpetual motion. It is obvious that the resistance to decomposition offered by the salts is a factor to be considered, as well as the electrical resistance of the solutions. Fifty electrolytic cells will offer fifty times the resistance of one cell; and, were there practically no other resistance in the circuit, or, if that other resistance were negligibly small, the current would be reduced to $\frac{1}{50}$ of its strength with one cell in circuit, and supposing one grain to be deposited in the single cell in a given time, $\frac{1}{50}$ grain would be deposited in each of the fifty cells.

Speed of Waves in Water.—M. Erington de la Croix, of Thaipeng-Pérak, has calculated the velocity of propagation of the tidal wave caused by the volcanic eruption of Krakatoa. The final moment of the explosion was about twelve minutes to noon, when a gigantic wave was formed in the Straits of Sunda. But the same day, at 1.30 p.m., a tidal wave was felt on the coasts of Ceylon, notably at Point de Galle. Assuming that this was the same disturbance propagated across the 3,000 kilomètres of sea dividing Point de Galle from Sunda, M. de la Croix calculates the velocity of propagation to be 2,000 kilomètres per hour, or 550 mètres per second. This rate is 210 mètres higher than the speed of sound in air. Further data from the island of Mauritius affords a check on this result. Here the distance is 5,500 kilomètres from Sunda, and the tidal ebb was felt at 2·15 p.m. Hence the speed per second works out as before, 550 mètres.—*Engineering.*

* The volt is the unit of E M F. See Knowledge, No. 44.

† The ohm is the unit of resistance. See Knowledge, No. 46.

‡ The ampère is the unit of current strength. See Knowledge, No. 51.

A FEW SATURNINE OBSERVATIONS.

(*Continued from page* 186.)

Well, in whatever way we may get there, we are off now for a stroll to Saturn, with Mr. R. A. Proctor for comrade and cicerone, but turning a deaf ear to him whenever, as often occurs, he is too learned for us, and asks us to "let N P′ P″ N′ represent the northern half of Saturn's orbit (viewed in perspective), *n* E n′ E′ the earth's orbit, and N p p′ p″ N′ the projection of Saturn's orbit on the plane of the earth's orbit. Let N S N′ be the line of Saturn's nodes on this plane, and let S P′ be at right angles to N S N′, so that when at P′ Saturn is at its greatest distance from the ecliptic on the northern side." When of such things we are asked to let them be, we let them be, and are, in the denseness of our ignorance, only too glad to be allowed, not to say asked, to do so. We attend only, like most of our neighbours, to what is easy to us. Sun is gold, and moon is silver; Mars is iron, Mercury quicksilver, which we, in fact, rather like still to call Mercury, thinking nothing at all of the imprisoned god with the winged heels, when we ask how is the mercury in the thermometer. Jove is tin, Yes, by Jove, tin is the chief among the gods, says little Swizzle, who, by a miracle, remembers one thing that he learnt at school—Jove's chieftainship among the heathen deities. Venus is copper, for the Cyprian is Cuprian; and as for Saturn, he is lead. A miserable old fellow they made Saturn out in the days of the star-decipherers. Mine, Chaucer makes Saturn say, is the drowning in wan waters, the dark prison, the strangling and hanging, murmur of discontent, and the rebellion of churls; I am the poisoner and the housebreaker, I topple down the high halls and make towers fall upon their builders, earth upon its miners; I sent the temple roof down upon Samson; I give you all your treasons, and your cold diseases, and your pestilence. This is the sort of estimation in which our forefathers held the respectable old gentleman we are now going out to see.

When Galileo's eyes went out towards Saturn through his largest telescope—which, great as were the discoveries it made, was clumsier and weaker than the sort of telescope now to be got for a few shillings at any optician's shop—he noticed a peculiarity in the appearance of Saturn which caused him to suppose that Saturn consisted of three stars in contact with one another. A year and a-half later he looked again, and there was the planet round and single as the disc of Mars or Jupiter. He cleaned his glasses, looked to his telescope, and looked again at the perplexing planet. Triform it was not. "Is it possible," he asked, "that some mocking demon has deluded me?" Afterwards the perplexity increased. The two lesser orbs reappeared, and grew and varied in form strangely; finally they lost their globular appearance altogether, and seemed each to have mighty two arms stretched towards and encompassing the planet. A drawing in one of his manuscripts would suggest that Galileo discovered the key to the mystery, for it shows Saturn as a globe resting upon a ring. But this drawing is thought to be a later addition to the manuscript. It was only after many perplexities of others, about half a century later, that Huyghens, in the year 1659, announced to his contemporaries that Saturn is girdled about by a thin, flat ring, inclined to the ecliptic, and not touching the body of the planet. He showed that all variations in the appearance of the ring are due to the varying inclinations of its plane towards us, and that being very thin, it becomes invisible when its edge is turned to the spectator or the sun. He found the diameter of the ring to be as nine to four to the diameter of Saturn's body,

and its breadth about equal to the breadth of vacant space between it and the surface of the planet.

The same observer, Huyghens, four years earlier, discovered one of Saturn's satellites. Had he looked for more he could have found them. But six was the number of known planets, five had been the number of known satellites (our moon, and the four moons of Jupiter, which Galileo had discovered); one moon more made the number of the planets and of the satellites to be alike, six, and this arrangement was assumed to be exact and final. But in sixteen-'seventy-one another satellite of Saturn was discovered by Cassini, who observed that it disappears regularly during one-half of its seventy-nine days' journey round its principal. Whence it is inferred that this moon has one of its sides less capable than the other of reflecting light, and that it turns round on its own axis once during its seventy-nine days' journey; Saturn itself spinning once round on its axis in as short a time as ten hours and a half. Cassini afterwards discovered three more satellites, and called his four the Sidera Lodoicea, Ludovickian Stars, in honour of his patron, Louis XIV. Huyghens had discovered, also, belts on Saturn's disc. Various lesser observations on rings, belts, and moons of Saturn continued to be made until the time of the elder Herschel, who, at the close of the last century, discovered two more satellites, established the relation of the belts to the rotation of the planet, and developed, after ten years' careful watching, his faith in the double character of its ring. "There is not, perhaps," said this great and sound astronomer, "another object in the heavens that presents us with such a variety of extraordinary phenomena as the planet Saturn; a magnificent globe encompassed by a stupendous double ring; attended by seven satellites; ornamented with equatorial belts; compressed at the poles; turning on its axis; mutually eclipsing its rings and satellites, and eclipsed by them; the most distant of the rings also turning on its axis, and the same taking place with the furthest of the satellites; all the parts of the system of Saturn occasionally reflecting light to each other—the rings and moons illuminating the nights of the Saturnian, the globe and moons enlightening the dark parts of the rings, and the planet and rings throwing back the sun's beams upon the moons when they are deprived of them at the time of their conjunctions." During the present century, other observers have detected more divisions of the ring, one separating the outer ring into two rings of equal breadth seems to be permanent. It is to be seen only by the best telescopes, under the most favourable conditions. Many other and lesser indications of divisions have also at different times been observed. Seventeen years ago an eighth satellite of Saturn was discovered by Mr. Bond in America, and by Mr. Lassell in England. Two years later—that is to say, in November, eighteen 'fifty, a third ring of singular appearance was discovered inside the two others by Mr. Bond, and, a few days later, but independently, by Mr. Dawes and by Mr. Lassell in England. It is not bright like the others, but dusky, almost purple, and it is transparent, not even distorting the outline of the body of the planet seen through it. This ring was very easily seen by good telescopes, and presently became visible through telescopes of only four-inch aperture. In Herschel's time it was so dim that it was figured as a belt upon the body of the planet. Now it is not only distinct, but it has been increasing in width since the time of its discovery.

These were not all the marvels. One of the chief of the wonders since discovered was a faint overlapping light, differing much in colour from the ordinary light of the ring, which light, a year and a half ago [this was written in 1865. R. P.], Mr. Wray saw distinctly stretched on either side from the dark shade on the ball overlapping the fine line of light by the edge of the ring to the extent of about one-third of its length, and so as to give the impression that it was the dusky ring, very much thicker than the bright rings, and seen edge-wise, projected on the sky. Well may we be told by our guide, Mr. Proctor, that no object in the heavens presents so beautiful an appearance as Saturn, viewed with an instrument of adequate power. "The golden disc, faintly striped with silver-tinted belts; the circling rings, with their various shades of brilliancy and colour; and the perfect symmetry of the system as it sweeps across the dark background of the field of view, combine to form a picture as charming as it is sublime and impressive."

But what does it all mean? What is the use of this strange furniture in the House of Saturn, which is like nothing else among the known things of the universe? Maupertuis thought that Saturn's ring was a comet's tail cut off by the attraction of the planet as it passed, and compelled to circle round it thenceforth and for ever. Buffon thought the ring was the equatorial region of the planet which had been thrown off and left revolving while the globe to which it had belonged contracted to its present size. Other theories also went upon the assumption that the rings are solid. But if they are solid, how is it that they exhibit traces of varying division and re-union, and and what are we to think of certain mottled or dusky stripes concentric with the rings, which stripes, appearing to indicate that the ring where they occur is semi-transparent, also are not permanent? Then, again, what are we to think of the growth within the last seventy years of the transparent dark ring which does not, as even air would, refract the image of that which is seen through it, and that is becoming more opaque every year? Then, again, how is it that the immense width of the rings has been steadily increasing by the approach of their inner edge to the body of the planet? The bright ring once twenty-three thousand miles wide, was five thousand miles wider in Herschel's time, and has now a width of twenty-eight thousand three hundred on a surface of more than twelve thousand millions of square miles, while the thickness is only a hundred miles or less. In 1857, Mr. J. Clerk Maxwell obtained the Adams prize of the University of Cambridge for an essay upon Saturn's rings, which showed that if they were solid there would be necessary to stability an appearance altogether different from that of the actual system. But if not solid are they fluid, are they a great isolated ocean poised in the Saturnian mid air? If there were such an ocean, it is shown that it would be exposed to influences forming waves that would be broken up into fluid satellites.

But possibly the rings are formed of flights of disconnected satellites, so small and so closely packed that, at the immense distance to which Saturn is removed, they appear to form a continuous mass, while the dark inner mass may have been recently formed of satellites drawn by disturbing attractions or collisions out of the bright outer ring, and so thinly scattered that they give to us only a sense of darkness without obscuring, and of course without refracting, the surface before which they spin. This is, in our guide's opinion, the true solution of the problem, and to the bulging of Saturn's equator, which determines the line of superior attraction, he ascribes the thinness of the system of satellites in which each is compelled to travel near the plane of the great planet's equator.

Whatever be the truth about these vast provisions for the wants of Saturn, surely there must be living inhabitants there to whose needs they are wisely adapted. Travel among the other planets would have its inconveniences to

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us of the earth. Light walking as it might be across the fields of ether, we should have half our weight given to us again in Mars or Mercury, while in Jupiter our weight would be doubled, and we should drag our limbs with pain. In Saturn, owing to the compression of the vast light globe and its rapid rotation, a man who weighs twelve stone at the equator weighs fourteen stone at the pole. Though vast in size, the density of the planet is small, for which reason we should not find ourselves very much heavier by change of ground from Earth to Saturn. We should be cold, for Saturn gets only a ninetieth part of the earth's allowance of light and heat. But then there is no lack of blanket in the House of Saturn, for there is a thick atmosphere to keep the warmth in the old gentleman's body and to lengthen the Saturnian twilights. As for the abatement of light, we know how much light yet remains to us when less than a ninetieth part of the sun escapes eclipse. We see in its brightness, as a star, though a pale one, the reflection of the sunshine Saturn gets, which, if but a ninetieth part of our share, yet leaves the Sun of Saturn able to give five hundred and sixty times more light than our own brightest moonshine. And then what long summers! The day in Saturn is only ten and a half hours long, so that the nights are short, and there are twenty-four thousand six hundred and eighteen and a half of its own days to the Saturnian year. But the long winters! And the Saturnian winter has its gloom increased by eclipses of the sun's light by the rings. At Saturn's equator these eclipses occur near the equinoxes and last but a little while, but in the regions corresponding to our temperate zone, they are of long duration. Apart from eclipses the rings lighten for Saturn the short summer nights, and lie, perhaps, as a halo under the sun during the short winter days.

THE MORALITY OF HAPPINESS.

By Thomas Foster.

CARE FOR SELF AS A DUTY.

(*Continued from page* 165.)

IT has been shown that care of self necessarily precedes care of others, because we must ourselves live if we are to benefit others. It has been shown further that if there is to be progress and improvement in the race, the superior must profit by their superiority, and so develop in numbers and influence, while the inferior because inferior become less and less predominant in the community. Further it has appeared that while a society improves as it becomes constituted more and more largely of the better sort, this improvement depends in large part on those qualities of the individual members of society which depend on due care of self. In like manner it appears that in a society whose members are not duly regardful of self misery arises from the excess of self-denial which ends by making those who practise it burdens on the rest of the community. Lastly, we have seen that due care of self is desirable, and neglect of the just rights of self injurious to the social body, because that undue care of self which is properly called selfishness and leads either to negative or positive forms of wrong-doing, thrives and multiplies in a community where the better sort allow evil and oppression to pass unchecked by the due assertion of self-rights.

But now it is worth remarking that the line of reasoning which has been followed does not in reality indicate changed conduct. It reconciles the actual conduct of the better sorts of men with rules derived from observed facts and laws in regard to the development of conduct, and would tend to reconcile their conduct with their words, if men in general would but recognise the folly and danger of a system by which they have one set of rules on their lips and another for their actual guidance. As Mr. Herbert Spencer well puts it, the general conclusion to which we have been led, "though at variance with nominally accepted beliefs is not at variance with actually accepted beliefs; while opposed to the doctrine which men are taught should be acted upon, it is in harmony with the doctrine which they do act upon and dimly see must be acted upon." "The labourer looking for wages in return for work done, no less than the merchant who sells goods at a profit, the doctor who expects fees for advice, or the priest who calls the scene of his ministrations a 'living,' assumes as beyond question the truth that selfishness, carried to the extent of enforcing his claims and enjoying the returns his efforts bring, is not only legitimate but essential. Even persons who avow a contrary conviction prove by their acts that it is inoperative. Those who repeat with emphasis the maxim—'Love your neighbour as yourself,' do not render up what they possess so as to satisfy the desires of all as much as they satisfy their own desires. Nor do those whose extreme maxim is—'Live for others,' differ appreciably from people around in their regards for personal welfare, or fail to appropriate their shares of life's pleasures. In short, that which is set forth above as the belief to which scientific ethics lead us, is that which men do really believe, as distinguished from that which they believe they believe—or pretend they believe."

Which is better?—to proclaim with our lips rules of conduct which none of us really follow and to denounce those who show that the rules which the best-minded among us really strive to follow are such as tend most to improve the condition of the body social, or frankly to recognise the just and equitable rules of conduct which after all are the real guides of the actions of all well-meaning men? Is it well or wise to discredit these fair and proper rules by setting up others which seem more self-sacrificing, but which none except a few abnormally-minded persons of no influence (objects of ill-concealed contempt among those who applaud such rules) actually strive to follow, rules moreover which if widely followed would inevitably bring misery on the community? For my own part I believe that the system by which rules no sane man follows are set up as the real laws of conduct, works most serious mischief, by discouraging many from the attempt to be consistently fair and just to those around them as well as to themselves. Of what use, they feel (rather than consciously think) is any attempt to be merely just and considerate, when still we fall far short of the standard set up for our guidance? Apart from this lies the direct mischief to character which necessarily arises from the confident expression of acceptance of rules which every man (except the few abnormal creatures I have mentioned) knows well that he does not follow, has never attempted to follow, and never intends to follow. Many are led, through their honest unwillingness thus to falsify their words by their actions, into an error of the opposite kind; preferring rather to maintain rules of conduct which have a selfish aspect, while their actual conduct is unselfish, than to ape a degree of disinterestedness which they do not possess and which would (they know) be mischievous if really possessed and acted upon by any large proportion of the community.*

* It is, by the way, rather remarkable that in proportion to the apparent zeal with which some maintain the doctrine of universal love is the intensity of hate which they express and doubtless feel (being in this at least, let us hope, honest) for those who differ from them. If the Honeythunder School of Philanthropists act

But lastly, let it be noticed that just care for self does not imply necessarily less care for others, but often more. As a mere matter of fact, men who carefully consider their own just claims are found to be more considerate, as a rule, of the claims of others, than those who assert that men ought not to be careful to consider what their just claims are. Horace long since, in his famous ode beginning *Justum ac tenacem propositi virum*, drew attention to the connection commonly existing between justice and firm maintenance of what is due to self. Of course there are men who are unduly regardful of self, not being content with the maintenance of their own rights but wilfully infringing the rights of others. Equally are there some who while negligent of their own rights are considerate of those of others. But these are the exceptions. As a rule one may recognise in *due* regard for self-rights the same principle which displays itself otherwise in care for the rights of others. Considering social as distinguished from individual opinions, assuredly Mr. Spencer is justified in what he says on the egoistic excesses which often accompany excessive altruism:—"A society in which the most exalted principles of self-sacrifice for the benefit of neighbours are enunciated, may be a society in which unscrupulous sacrifice of alien fellow-creatures is not only tolerated but applauded. Along with professed anxiety to spread these exalted opinions among heathens, there may go the deliberate fastening of a quarrel upon them with a view to annexing their territory. Men who every Sunday have listened approvingly to injunctions carrying the regard for other men to an impracticable extent, may yet hire themselves out to slay, at the word of command, any people in any part of the world, utterly indifferent to the right or wrong of the matter fought about. And as in these cases transcendent altruism in theory coexists with brutal egoism in practice, so conversely a more qualified altruism may have for its concomitant a greatly moderated egoism. For, asserting the due claims of self is, by implication, drawing a limit beyond which the claims are undue; and is, by consequence, bringing into greater clearness the claims of others."

We have next to consider the duty of caring for others, as it presents itself in connection with the Morality of Happiness. (*To be continued.*)

WEEVILS.

BY S. A. BUTLER, B.A., B.Sc.

(*Continued from page* 161.)

ANOTHER creature, black and stumpy, and almost as broad as it is long, infests cabbages and other cruciferous plants. It has a short but slender rostrum, which it is able to bend completely under its body; this is rendered possible, not by any articulation of the rostrum to the rest of the head, but by the extreme mobility of the head itself, which fits into the front of the thorax by a kind of ball and socket arrangement. When the insect has thus tucked its rostrum under its body, it folds up its legs and packs them close to the body, and then looks more like a seed or a little lump of earth than anything animate. In this condition it may, like a ladybird, be handled in any way without manifesting the slightest sign of life. Feigning death is a habit commonly indulged in by beetles, and though not confined to that order of insects, is of more frequent occurrence amongst them than in other groups. Several genera of weevils manifest this habit in a most striking degree, and the apparent enlargement of the insect as it stretches out its legs again, brings forward its rostrum and opens out its antennæ, is most surprising. The black weevil referred to above is only $\frac{1}{9}$-inch long and belongs to a large genus called *Ceuthorhynchus*, containing about forty British species, which affect various plants. The female beetle lays her eggs on the stems of cabbages near the root, in small perforations which she makes with the jaws at the end of her rostrum. Around the grubs which hatch from these, gall-like excrescences are formed; the grubs feed on the interior, and the galls increase in size with the growth of the cabbage, thus nourishing the grub at the expense of the plant. The maggot, when fully grown, nibbles its way through the rind of the gall, goes into the earth and there forms a cell in which it changes to a pupa, which, in the course of about two months, yields the perfect insect.

The nut-weevil, *Balaninus nucum*, which is remarkable as having almost the longest and slenderest rostrum to be found amongst British weevils, is covered with greyish or yellowish-brown scales, except the rostrum, which is almost bare. With the tiny mandibles at the end of her long rostrum, the female gnaws a hole through the shell of a young nut, while it is still soft, and then deposits therein an egg, which hatches in about ten days. As the nut grows, the weevil grub gradually devours the kernel, and finally eats its own way through the nutshell, either after the nut has (somewhat prematurely) fallen, or before this takes place. The grub falls to the ground, buries itself, and snugly ensconces itself in the soil in a cell of its own manufacture. In this condition it frequently passes the winter, changing in the following spring to a pupa, whence in due course issues the perfect beetle.

Another insect of a reddish colour, with white bands on its back, treats the flower-buds of apple trees in a similar way, devouring all the central organs of the buds and so rendering them abortive. Instead of falling to the ground, however, it undergoes all its metamorphoses cradled in the bud itself.

A species found commonly on lucerne, makes of a gummy substance it secretes, a delicate oval cocoon of open network, on a leaf of its food-plant; in this it encloses itself, as in a cage, in order to pass through its pupahood.

One of the largest of our British species, the Pine Weevil, *Hylobius abietis*, attacks various trees of the pine family. It is a blackish-brown creature, with yellowish markings. The beetle itself devours the tender bark of young twigs, sometimes completely stripping them. The eggs are deposited in various situations where the larvæ will be able to find easy access to the wood of the trees. The grubs, on hatching, begin to tunnel under the bark, forming galleries, the dimensions of which are increased as the insect grows. In course of time, after many months of mining and depredation, these galleries become partially filled with what is called "worm-meal," the remains of the wood-gnawing of the larvæ, and if the burrow be traced to its end, there will be found a snug little cavity hollowed out amongst the chips, where the pupa nestles. The beetles pass about a month in the pupa state, and then issue as perfect insects to pursue their devastations upon the vegetable products of another season. Many wild plants are particularly liable to the attacks of weevils. The figworts (*Scrophularia*) may sometimes be seen in July and August with their leaves all brown and withered, and riddled through and through with tiny holes, as though they had received charge upon charge of miniature shot. This is the work of some very beautiful insects, the genus *Cionus*, which have a squarish body, handsomely adorned with variegated, hair-like scales.

This paper must not be concluded without a reference to

seemingly on the principle, "Curse your souls and bodies come here and be blessed," these seem to adopt as their rule, "Let us hate with all our might those who will not allow us to love every one better than ourselves."

two insects, for the presence of which in Britain we are indebted to our extensive commerce—the corn and rice weevils, *Calandra granaria* and *oryzæ*. These are not truly British insects, but were originally accidentally introduced from abroad with foreign wheat. They feed, not upon growing plants, but upon grain, after it has been stored up. They are small, reddish-brown beetles, about $\frac{1}{8}$ in. long. The parent deposits a single egg in each grain; the larva developed from this lives inside the grain, gradually consuming all the interior, and leaving only the husk, which, however, remains intact, so that no trace of the depredator is noticeable. Inside the husk the little being pupates, and when fully developed, it easily ruptures its prison walls and makes its exit, a perfect beetle, on the look-out for a mate, and prepared to renew, probably to a much greater extent than before, the work of destruction. Though individually minute, and making no further call upon the corn-merchant's stores than the contents of a single grain for the nourishment of each during its larvadom, these insects are so prolific, and occur in such enormous numbers as to be terribly destructive, and sometimes to entail serious loss upon the owners of the grain.

Fig. 3.
Corn Weevil.

Owing, however, to improved appliances, and greater care in the shipping and storage of the grain, the damage done now-a-days is much less than formerly. I am informed by a friend who has had much experience in these matters, that the beetles do not readily breed in this country, and that most of the damage wrought by the larvæ is effected before the grain arrives here, the chief depredators after it is actually stored being the perfect insects themselves. These, however, occasionally occur in immense swarms, and there are on record instances of such vast numbers having been screened out of infested corn that they could be weighed only by the hundredweight! Weevils are not the only beetles that attack corn in this way. On one occasion, no less than twenty species belonging to several families were obtained in varying numbers from a small collection of granary-sweepings, which yielded in all six ounces of insects, containing over 2,000,000 specimens. Facts like these go far to show the economic importance of entomology, an aspect of the science that, curiously enough, has not until recently attracted much attention in this country; one reason for this may, no doubt, be found in the fact that unfortunately agricultural and entomological tendencies do not often co-exist in the same individual.

ALMANAC LESSONS.

By Richard A. Proctor.

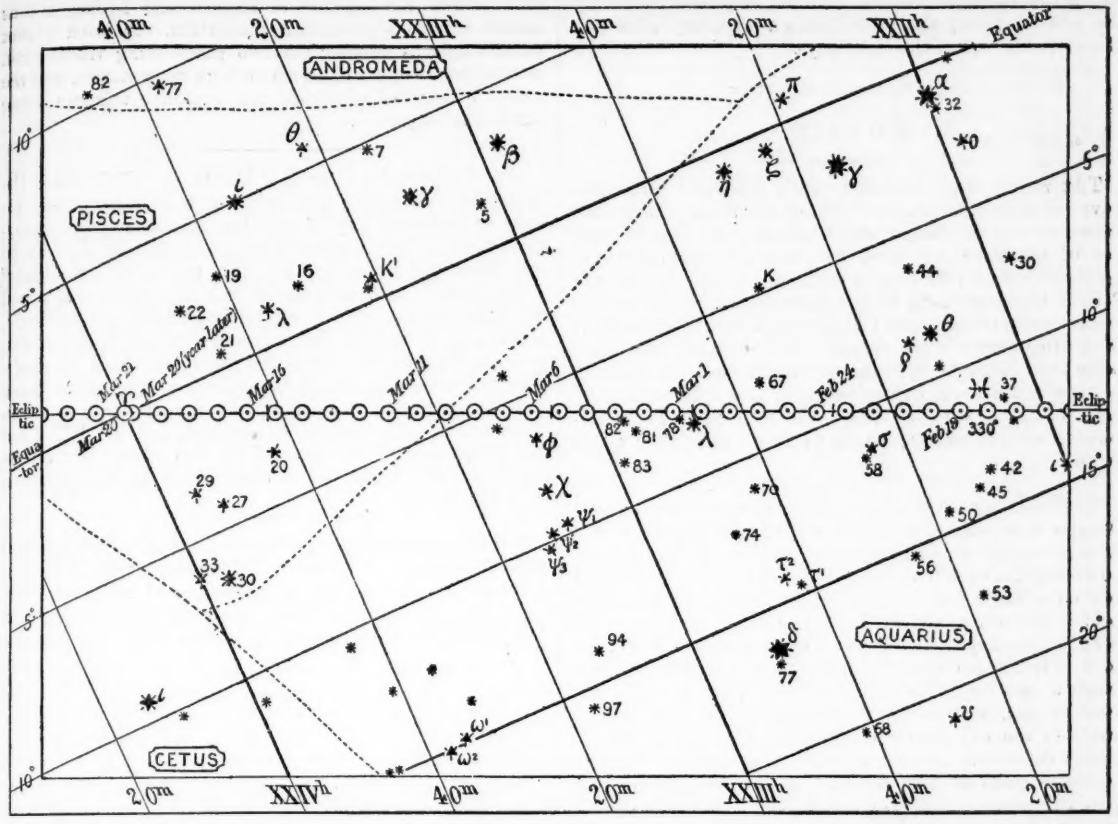
DURING the months of February and March, the sun's hour of rising ranges from 7h. 42m. to 5h 38m., his hour of setting from 4h. 46m. to 6h. 30m. The time of southing ranges from 13m. 43s. p.m. at the beginning of February to 14m. 28s. p.m. on the 11th, and thence to 4m. 4s. p.m. at the end of March. The following table represents these changes as they actually occur, the last column showing how the equation of time, or the interval between clock noon and solar noon, varies throughout the two months.

If the student remembers that the earth reaches her mean distance—on her way towards aphelion—near the end of March, so that all this time the sun moves with rather more than his mean apparent velocity eastwards, he will see that so far as the equation of time depends on this relation it would be increasing to the end of March. But as during the last half of the quarter ending March 20th, the sun is crossing the meridianal circles aslant, and where they are farther apart, so that he is passing westwards less quickly than the average, the equation of time more rapidly diminishes. Hence after attaining a maximum in the second week of February, the equation of time diminishes steadily to and beyond the end of March.

A study of the Day-Sign Maps for last month and this (the latter appears this week) will make it plain that about February 11 the sun has his average eastwardly motion, and thereafter less than the average, so that each day he loses more and more of that easting which makes him come to the meridian, or due south, after clock noon.

On February 19 the sun enters the sign Pisces, on March 20 he enters the sign Aries.

	The Sun Rises.	The Sun Sets.	After Clock.	Hourly Variation of Equation of Time.
	h. m.	h. m.	m. s.	s.
Feb. 1	7 42	4 46	13 47	+0·34
„ 2	7 40	4 48	13 55	0·31
„ 3	7 38	4 50	14 2	0·27
„ 4	7 37	4 51	14 8	0·24
„ 5	7 35	4 53	14 13	0·20
„ 6	7 33	4 55	14 18	0·17
„ 7	7 32	4 57	14 21	0·13
„ 8	7 30	4 59	14 24	0·10
„ 9	7 28	5 1	14 26	0·07
„ 10	7 26	5 2	14 27	+0·03
„ 11	7 25	5 4	14 28	±0·00
„ 12	7 23	5 6	14 27	−0·03
„ 13	7 21	5 8	14 26	0·06
„ 14	7 19	5 10	14 24	0·09
„ 15	7 17	5 12	14 22	0·12
„ 16	7 15	5 13	14 19	0·15
„ 17	7 13	5 15	14 15	0·18
„ 18	7 11	5 17	14 10	0·21
„ 19	7 9	5 19	14 4	0·24
„ 20	7 7	5 21	13 58	0·27
„ 21	7 5	5 23	13 52	0·29
„ 22	7 3	5 24	13 45	0·32
„ 23	7 1	5 26	13 37	0·34
„ 24	6 59	5 28	13 28	0·37
„ 25	6 57	5 30	13 19	0·39
„ 26	6 55	5 32	13 9	0·42
„ 27	6 53	5 33	12 59	0·44
„ 28	6 50	5 35	12 48	0·46
„ 29	6 48	5 37	12 37	0·48
Mar. 1	6 46	5 39	12 25	0·51
„ 2	6 44	5 40	12 13	0·53
„ 3	6 42	5 42	12 0	0·55
„ 4	6 40	5 44	11 46	0·57
„ 5	6 37	5 46	11 32	0·59
„ 6	6 35	5 47	11 18	0·60
„ 7	6 33	5 49	11 3	0·62
„ 8	6 31	5 51	10 48	0·64
„ 9	6 29	5 53	10 33	0·65
„ 10	6 26	5 54	10 17	0·67
„ 11	6 24	5 56	10 1	0·68
„ 12	6 22	5 58	9 45	0·69
„ 13	6 20	5 59	9 28	0·70
„ 14	6 17	6 1	9 11	0·71
„ 15	6 15	6 3	8 54	0·72
„ 16	6 13	6 5	8 36	0·73
„ 17	6 10	6 6	8 19	0·74
„ 18	6 8	6 8	8 1	0.74
„ 19	6 6	6 10	7 43	0·75
„ 20	6 4	6 11	7 25	0·75
„ 21	6 1	6 13	7 7	0·76
„ 22	5 59	6 15	6 49	0·76
„ 23	5 57	6 16	6 30	0·76
„ 24	5 54	6 18	6 12	0·76
„ 25	5 52	6 20	5 54	0·77
„ 26	5 50	6 21	5 35	0·77
„ 27	5 47	6 23	5 17	0·76
„ 28	5 45	6 25	4 59	0·76
„ 29	5 43	6 26	4 40	0·76
„ 30	5 41	6 28	4 22	0·76
„ 31	5 38	6 30	4 4	−0·76



THE DAY-SIGN FOR MARCH.

WE give this week the day-sign for the month, with the sun's course thereon,—not as given in the almanac for this year, but as it would be during the first 11 days of a year beginning on March 20th, and during the last 20 days of such a year—so that, we have for March 20 *two* positions of the sun, corresponding to the extra quarter day in the solar year of $365\frac{1}{4}$ days.

COLLEGE EIGHT-OARED RACES AT CAMBRIDGE.

THE principal college races are the eight-oared bumping races. Every club sends in one or more boats to take part in these races, and the result is that some forty or fifty boats contend in them. It will readily be conceived that this number would be largely diminished if the object of the races were merely to determine which club could supply the best eight. Thirty or forty boats, having no chance from the beginning, would be withdrawn. But the races are so managed that every boat goes in with a fair chance of victory. The boats are arranged in two divisions, and each division starts some twenty or twenty-five boats, one behind the other, in each race. A boat that can draw up to and touch the boat in front has gained a victory; the coxswain hoists the club-flag in the stern of the boat, and the men row rejoicingly home. Next day both the vanquished boat and the victorious one again take part in the race, but they exchange places. Perhaps the vanquished boat may now be "bumped" by the boat next behind; or they may retrieve their defeat by bumping their former victors; or they may remain, as Mr. Micawber would say, *in statu quo*. So the victorious boat of the day before may make a new conquest (or "rise another place," as it is technically expressed), or be "bumped back again," or remain where they were. This process goes on all along the line of boats for eight days, by which time the boats have commonly begun to find their proper places. It often happens, however, that a good boat which happens to be low down will make bump after bump all through the eight days of the races. There is a notion that when this happens the victorious boat may challenge any boat above it to a time-race over the racing-course, and if victorious take that boat's place. But this is a myth. Year after year the eight-oar races are renewed, the boats commencing each set of races in the places they occupied at the end of the preceding year's races. There are, of course, continual changes of fortune. Sometimes a college which has managed to become "head of the river," that is, to get the first place of all, will maintain that place for several years, and then the loss of two or three good oarsmen will give the boats behind a chance. Then the opening day of the races is looked forward to with intense excitement. Whether Jesus, Trinity, or John's, as the case may be, will keep the headship or not becomes the great question with all the rowing men of the University. The practice of the best boats is watched and timed, bets are made for and against the leading clubs, and all sorts of reports get abroad as to the condition of the crews. Usually the struggle for pride of place is a close one. Sometimes the head boat will escape bumping as by a miracle for several days, and at last be run into close by the winning-post. At others, the first

day of the races settles the question, and then frequently the late "head of the river" loses a place day after day almost to the end of the eight days.

Gossip.

The recent fatal explosions with lime-light apparatus have naturally excited a good deal of attention. They have shown at once the danger which arises from the ignorant use of explosive mixtures, and the singular extent of ignorance about very simple matters. A collection of the various blunders made in the newspaper accounts of the explosions at Oldham and Chedderton would be amusing if the matter were not so serious. Unfortunately the ignorance thus displayed by those who could hardly be expected to know much about explosive gases, is displayed also by some of those who, as they use such gases in magic-lantern entertainments, ought to know something about them.

The following ideas are prevalent, it would seem :—(1) Oxygen is an explosive gas : it will certainly explode if a light is brought near it, but it *may* explode if the temperature around is unduly raised,—as for instance in a crowded hall on a warm day. (2) Hydrogen also is an explosive gas : it will certainly, &c., &c. (3) Oxygen and hydrogen must both be kept under pressure or they will explode anyhow. (4) Oxygen escaping into a room, through any hole which a member of an audience may prod through the pressure bag, will poison those around. (5) The intense lustre of the oxyhydrogen flame (*sic*) shows what an intensely dangerous mixture we have to deal with. (6) The explosive gases used to obtain the electric light are still more dangerous. Hence (7) "no person" (says the coroner's jury at Chedderton) "should be permitted to give public exhibitions in which explosive gases are employed, without a licence." And (8) lastly, "we" says the *Globe*, "would go a little further by adding, 'and the State should refuse licences for that purpose.'"

The ideas numbered above are to some slight degree erroneous from the first even unto the last.

Let us consider under what circumstances explosion can arise, and we shall be able to see, first how safety may be secured by due care suggested by knowledge, and secondly, how safety may be secured without any care at all, which is the kind of safety people want when they have no means of knowing whether the lantern manager is a person of experience or not.

In the ordinary form of an oxyhydrogen lamp we have such an arrangement as is shown in the accompanying figure. L is a cylinder of lime ; F (Fig. 1) is a flame produced by igniting a mixture of oxygen and hydrogen issuing from a jet J ; O is the pipe by which the oxygen is conveyed to the jet, H that by which the hydrogen is brought there, each gas being forced by pressure towards J. (Instead of hydrogen the ordinary lighting gas—carburetted hydrogen—is often employed, in which case the pressure is applied at the gas-works.) Now so long as the pressure is maintained equally on the two gases, this arrangement is perfectly safe. But suppose the pressure much reduced on either the oxygen or the hydrogen, then it is obvious that the gas which is under greater pressure will force its way into the vessel intended only to hold the other gas. When the mixture of oxygen and hydrogen thus formed attains a particular proportion, explosion occurs when a light is applied, the two gases being transformed into aqueous vapour or steam at high temperature, and the vessel which had contained the explosive mixture being burst into fragments.

At Indianapolis I gave a lecture in 1876, where the lanternist used strong iron cylinders to hold his gases; his careless haphazard way of working caused me more annoyance than anxiety, because I supposed that careless as he was he would never use his two gas cylinders without making sure that in each the gas was adequately compressed to ensure safety. But I was really lecturing, unwittingly, at the risk of my life ; for, only a short time after, this man so mismanaged matters that the gases got mixed in explosive proportion in one of the cylinders, the result being that the cylinder was burst like a shell, and two men were killed. The lanternist survived, and in 1879 I had the pleasure of being assisted by him again, but not at Indianapolis. I was not so comfortable on the platform as I like to feel.

I have now always my own lantern, and it is provided with the arrangement which is safe even though the lantern manager should not only be inexperienced but homicidally disposed. F (Fig. 2) is a flame produced by igniting a mixture of oxygen and hydrogen issuing from *two* jets, one

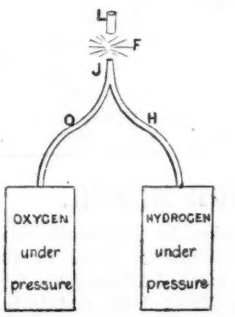


Fig. 1.—Arrangement which is safe with due care.

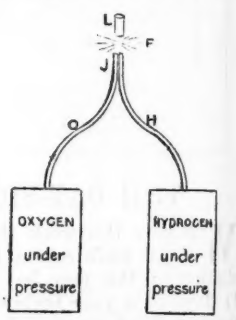


Fig. 2.—Arrangement which is safe with or without care.

supplied with oxygen by pipe O, the other with hydrogen by pipe H. Then it is obvious that if the pressure is not properly maintained the oxyhydrogen flame will wax faint, but neither gas can get into the compartment holding the other gas, for there is no connection between the two compartments.

I luckily have the cleverest and coolest assistant,—though young,—that I have ever known. But if, unfortunately, I had to employ on any occasion one of the most nervous and excitable temperament, or as careless as my actual assistant is careful, no harm could happen either to my audience or myself,—except delay and bad lighting.

I have made another calculation of the rotation-period of Mars, using as before old Hooke's observation of March, 1666, at the further end, and a recent observation at the nearer. It is hardly necessary to say that no correction has been introduced, or could be, through the extension of the long period by a few years only. The period comes out as before—24 h. 37 m. 22·7s. I never felt any doubt about this value except when I found that Kaiser, of Leyden, made the period 24 h. 37 m. 22·6 s., using like myself some

200 years' observations. Then, knowing his accuracy, I expected to find I had made some mistake somewhere. But detecting none, I went carefully through his work, and found an excess of two days in all his intervals between the seventeenth and the nineteenth centuries. I have no doubt this arose from his counting the years 1700 and 1800 as leap-years, whereas, these numbers not being divisible by 400, those years were common years.

IF any observer, armed with a good telescope and suitable micrometric appliances, will send me any times of the central passage of Kaiser's Sea, or—perhaps preferably—of the cape from which Beer and Mädler counted Martian longitudes (it has been named, but not by me, Proctor Cape) I will compute the rotation-period starting both from Hooke's observation in 1666 and from those observations by Huyghens which Kaiser employed, though as a matter of fact they give appreciably the same result.

THE rotation-period of Mars thus determined serves to test time-observations of Mars' rotation extending over any period from a few months to twenty or thirty years. It cannot (as some seem to imagine) be tested by them—any more than a clock rated within five seconds per month could be corrected by a chronometer only rated within a second per day.

AT last we have settled how our Chess columns will in future be arranged. It is meant for home chess-players, just as the hints and suggestions of "Five of Clubs" are meant for home whist-players, though many club-players show lamentable ignorance even of the simple principles which our Whist columns expound. As I am myself only a home chess-player (having never taken part in any public chess or been a member of any chess club) I know what they want better than the professional player can be expected to do. Their usual shortcoming is found in a lamentable ignorance not only of the best openings but of the principles on which the openings at chess depend. But they do not need elaborate analysis of the openings, twenty moves deep. They will not follow lines of play which seem to require so much study. But on the other hand the discussion of elementary principles is not needed. I propose therefore to submit fortnightly to the supervision of the brilliant "Mephisto" such simple expositions of the more familiar lines of opening as may serve, if followed, to change the haphazard opening play of the average home player to such sound, well-considered lines of play as can alone make chess interesting. For chess, as it is too commonly played in the home circle, is little better than a chance game, and no more deserves to be regarded as a scientific recreation, really valuable because requiring and exercising skill, than does that preposterous four-handed card game which many of the "folks at home" imagine to be whist.

IN response to numerous requests, "Five of Clubs" will take an early opportunity of quoting the half column in which he summarised all the leads which have commonly to be considered at whist. Ten minutes devoted to the study of this very short and simple summary would save bewildered partners much anguish and tribulation of spirit.

I MAY remind my readers that the third and fourth of my Series of Lectures in the Memorial Hall, Farringdon-street, will take place on Monday and Thursday of next week, and that in the same week I shall lecture at Brixton Hall. It is gratifying to receive as warm a welcome in the metropolis as was accorded me in the provinces.

POETRY OF SCIENCE.—There are some who seem to think that science cannot be truly called science if clothed in poetic garb. And on the other hand there are those who seem to fear lest the grace and beauty of the universe should be lost, lest a glory should depart from the face of nature, if science should scrutinize the mysteries of nature too closely. These fears are alike uncalled for. Science need not be less exact though poetic fancies underlie its teachings; while beautiful and glorious though the aspect of nature, as all can see her, may be, a deeper poetry, a more solemn significance, a greater beauty and a nobler glory, exist in the aspect of nature as she is seen when science raises the veil which hides her features from ordinary vision. It may indeed be truly said that no one who studies aright the teachings of the profoundest students of nature, will fail to perceive that the Galileos, the Keplers, and the Newtons, the Priestleys, the Faradays, and the Tyndalls, have been guided in no small degree by poetic instincts—nay that their best scientific work has owed as much to their imagination as to their reasoning and perceptive faculties. On the other hand, from the time when Shakespeare penned that noble apostrophe to the stars:

> There 's not an orb that thou behold'st
> But in his motion like an angel sings,
> Still quiring to the young-eyed Cherubim,

and later, as the true theory of the universe dawned on mankind, our great epic poet presented in a grand passage of the "Paradise Lost" the theories of Galileo, we have again and again had occasion to perceive that the truths of science are even more impressive to the true poet than the more direct and obvious teachings of nature. Certainly if we consider how largely the universe, as disclosed under the scrutiny of science, surpasses in splendour the aspect of nature as seen by the ordinary eye, we cannot but feel that this should be the case; and that though the eye hath not seen, nor can ever see, the real glories of the universe, yet it may enter the heart of man to conceive something of the significance of those results which science is bringing to light.—R. P.

TELEGRAPHIC COMMUNICATION BETWEEN ENGLAND AND SCOTLAND.—In the House of Commons, recently, in reply to Mr. Buchanan, Mr. Fawcett said interruptions of telegraphic communication between England and Scotland have been very frequently under consideration. They have not occurred in any particular locality, but have been experienced in various parts of the country traversed by the several main lines of telegraph between London and Scotland. The placing of any one section of the lines underground would not, therefore, insure immunity from interruption, while the cost of substituting underground wires for overground throughout the United Kingdom, or even between the principal towns, would be very great, probably not less than a million and three quarters.

A WIRE FENCE TELEGRAPH.—On the Milwaukee and St. Paul Railway and the Brandon branch, experiments have been made of late to see whether or not the barbed wire fence on either side of the line could be used for telegraphing through. The wire was run under the surface at level crossings to make the line continuous, and trials were made which showed that telegraphing could be done through the fence. Mr. Simpson, superintendent of telegraphs on the railway, is, however, of opinion that in winter the snow wreaths covering the fence would prevent working, and thus render the line useless for every-day use; but Mr. Simpson appears to forget that dry snow insulates, and is probably not aware that in some parts of Norway the winter lines are laid on the surface of the snow. A thaw would perhaps prevent working; but even then the telephone might serve.—*Engineering.*

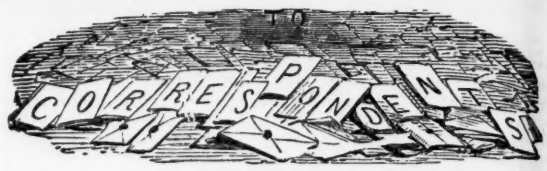
THE FACE OF THE SKY.

From March 28 to April 11.

By F.R.A.S.

THE usual watch will be kept on the Sun for spots, faculæ, &c. The Zodiacal light may still be seen during the earlier part of the next fortnight. The night sky is shown in Map IV. of "The Stars in their Seasons." Mercury, emerging from behind the Sun, is coming into a favourable position for the observer, and may be detected by the naked eye over the west-by-northern part of the horizon after sunset, about the time these notes terminate. Venus is now a most brilliant and conspicuous object in the evening sky, and even at the beginning of April does not set until 10h. 48m. p.m. By the 11th it is between 11 and 12 o'clock at night ere she disappears below the horizon. Mars is visible all night long in Cancer (Zodiacal Map, p. 70), but is gradually diminishing in apparent diameter. On the night of April 6th he will be less than $\frac{1}{2}^{\circ}$ south of γ Cancri. Jupiter is also visible during the working part of the night, but being nearer the west than Mars, will be best placed for the observer between sunset and 9h. 30m. p.m. He is in the confines of Gemini and Cancer. (Zodiacal Map, p. 40.) The phenomena of his satellites, visible before 1 a.m. during the period covered by our notes, are both numerous and interesting. Beginning with to-morrow night (29th), the transit of Satellite II. will begin at 10h. 11m., and the shadow of Satellite IV. will enter on to the planet's disc at 11h. 56m. p.m. The shadow of Satellite II. will not commence its transit until 38 minutes after midnight. On March 31st, Satellite II. will reappear from eclipse at 10h. 31m. 26s. p.m.; and the transit of Satellite I. begin at 11h. 52m. On April 1, Satellite I. will be occulted at 9h. 1m.; to reappear from eclipse at 12h. 34m. 13s. p.m. On the 2nd, the ingress of the shadow of Satellite I. happens at 7h. 35m.; the satellite casting it passing off Jupiter's opposite limb at 8h. 39m., and being followed by the shadow at 9h. 55m. p.m. On the 3rd, Satellite III. passes off Jupiter's preceding limb at 8h. 50m. p.m.; the shadow which it casts actually not entering on to the opposite limb of the planet until 10h. 21m. On the 5th, the transit of Satellite II. commences 45m. after midnight. On the 6th, Satellite IV. will be occulted at 9h. 45m. p.m. On the 7th, Satellite II. will be occulted at 7h. 43m.; as will Satellite I. at 10h. 55m. p.m. on the 8th. On the 9th, the transit of this same Satellite begins at 8h. 13m. p.m.; followed by that of its shadow at 9h. 30m. The satellite leaves Jupiter's opposite limb at 10h. 33m.; the shadow at 11h. 50m. p.m. On the 10th, Satellite I. will reappear from eclipse at 8h. 58m. 36s. p.m.; and Satellite III. begins its transit at 9h. 12m, the egress of this last named satellite occurring at 12h. 46m. p.m. Saturn now souths in bright sunlight, but may be seen low down in the west to the north of ϵ Tauri ("The Stars in their Seasons," Map I.) as soon as it is dark enough. Uranus is now in Virgo, in an excellent position for the observer. On the night of April 1st he will be only 8′ north, and just to the west of β Virginis ("The Stars in their Seasons," Map V.). Neptune is invisible. The moon's age at noon to-day is 1·3 days; and, pretty obviously, it will be 15·3 days at the same hour on April 11th. No occultations will be visible during the succeeding fourteen days. At noon to-day the moon will be in Pisces; but at 3 o'clock in the afternoon will pass into that little corner of Cetus intruding between parts of Pisces and Aries, which latter constellation she will enter at 11 o'clock to-night. She will not quit Aries for Taurus until 6 a.m. on the 30th. Travelling all next day through Taurus, she will, at 4 p.m. on April 1, enter the extreme northern part of Orion, which she will traverse in, as nearly as may be, twelve hours, emerging in Gemini at 4 o'clock on the morning of April 2. Between 7 and 8 p.m. on the 3rd she crosses the boundary of Gemini into Cancer, which constellation she leaves for Leo at 11 a.m. on the 5th. At noon on the 8th she descends into Sextans, across which she travels until, at 5 o'clock in the morning of the 7th, she re-emerges in Leo. She occupies until 7 a.m. on the 8th in crossing Leo, and at the hour just named enters Virgo. Her journey across this great constellation takes her until 5 p.m. on April 11 to accomplish, and she then crosses the boundary into Libra. We there leave her.

THE first enterprising Londoner who introduced conduit water to his premises was—the *Builder* says—a tradesman of Fleet-street. In a record of 1478 it is mentioned that "a wex-chandler in Flete-strete had by crafte perced a pipe of the condit withynne the ground, and so conveied the water into his selar; wherefore he was judged to ride through the citie with a condit uppon his hedde," and the City Crier was to walk before him proclaiming his offence.



"Let Knowledge grow from more to more."—Alfred Tennyson.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

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DAY GLOW AROUND SUN.

[1158]—The above effect does not appear to have attracted the notice of your astronomical correspondents. We seem here to have lost the wonderful "afterglow" and "early glow," but on several occasions the sun has had surrounding him—some 15° each way from him—a very beautiful salmon-red ring of soft, diffused light.

I find on blocking or blotting the sun out with any opaque object held at arm's length, or, better, when he is hid behind a building or between cumulus cloud, the circle and contrast with the blue sky outside and the silvery light inside it form a very beautiful effect.

Has this any connection with recent displays—the "dust-cloud" theory, &c.? or, may the cloud, of whatever matter it may consist, be departing—condensing, and thus be only visible in the sun's immediate vicinity?

Thos. Radmore.

142, North-road, Plymouth, *March* 21, 1884.

THE FRETFUL PORCUPINE—KRAKATOA AND THE COFFEE PLANT.

[1159]—One of your correspondents writing about porcupines a short time ago, referred to the popular notion of the manner in which these animals used to be supposed to discharge their quills at an adversary in self-defence. I have seen porcupines hunted many a time, in India, by dogs, and noticed a curious fact, which I fancy is not at all known. Dogs, of course, get the quills in their necks and faces in attempting to seize the porcupine, but the latter has a very curious trick of suddenly charging backwards when a man or dog comes c'ose behind it, so that the points of the quills act most effectively as offensive weapons. I remember a tame porcupine which was chained up to a kennel, and it often astonished people who approached within reach—especially coolies with bare legs—by this trick.

Referring to the article at p. 80, there is a curious circumstance bearing on the question of the dust being volcanic, which I believe has not been made known yet. Some of your readers may, perhaps, have heard of the extensive damage done to coffee in Ceylon and South India during the last half-dozen years by a fungus. For this disease the only remedy has been thought to be the application of sulphur, but to be effective this must be universal, and it was impossible to arrange that the cure should be applied to a whole district simultaneously. Now from a private letter from India, I hear that after the eruption in Java last year, the peculiar colour of the atmosphere and the greenish appearance of the sun were very marked for some months, and at the same time a decided improvement in the coffee was noticed. As to the disease, could this have been a universal application of sulphur vapour?

There was, by-the-by, a considerable glow in the sky last evening after sunset, and this morning (February 11), we have had a heavy hailstorm. I carefully collected some of the hailstones, and, after they melted, I examined the result in the microscope. They contained a considerable quantity of green plant-cells and spores of fungi; a few diatoms, one or two fragments of spiral vessels of plants, a few particles apparently mineral, and finally, what I take to be several specimens of either the egg of rotifera, or else the young rotifers in the oval form in which they are sometimes seen.

F.R.C.S.

INFINITY.

[1160]—Many persons appear not to understand that it is impossible for a *finite* being to comprehend infinity; and hence, I imagine, has arisen the "Edinburgh Reviewer's" attack on Mr. Spencer. There is no "continuity" between the finite and the infinite. The former cannot be either a multiple or sub-multiple of the latter. Thus, it is no wonder that "we cannot by searching find out God," when, even as regards "space," we find ourselves baffled. I had a talk once with the late Professor Clifford on the subject of infinitely small and infinitely great space. On my saying I *could* form a conception of the former, I replied to his question that "a *point* was infinitely small space"—it existed in space, but did not fill any space (being without extension), and was, therefore, in fact, "zero space." He would, therefore, I concluded, admit that there might be an infinite number of points between any two points, and yet he could not assert that there was *more* than an infinite number of points in the whole universe. These contradictory admissions clearly prove OUR utter incapability of understanding "infinity" even as regarded space. H.

[Yes: yet strangely enough men find more comfort in talking about infinity as if they understood it than in accepting the finite which can alone be comprehended.—R. P.]

THE MORALITY OF HAPPINESS.

[1161]—If any proof of the truth of your remark that "there can be no manner of doubt that rules of conduct are regarded by an immense number of persons as essentially associated with religious doctrines," were needed, it may be found in the fact that many people will but half-heartedly admit that a man may be capable of good conduct if he does not profess their own peculiar creed, but will stoutly deny that such conduct is impossible to him who professes no creed at all. The reason for this position is, I think, not far to seek. That conduct conduces to happiness is, perhaps, more conclusively insisted upon in the Bible than in any other book that is equally read; and those who regard the Bible as the inspired fount of their theology, cannot admit that a man may by his life prove this and yet not give his adhesion to their own or some kindred doctrine which they insist is built upon Biblical teaching. But that this proposition—"Conduct conduces to happiness"—is true, most people, indeed, I should say, all people, may prove to themselves by a little thoughtful introspection. Who without any reference whatever to religious sentiments, has not felt the pangs of remorse, when suffering from a sense of wrong-doing? Who has not felt a thrill of the most real and satisfying pleasure when, by the exercise of self-denial, he has conferred some benefit on a fellow-creature—thus receiving from his own conscience the direct assurance that the proposition is true? Yet conscience existed before the Bible, and before the Bible must have been susceptible of the same emotions that influence it now. It so happened that the Jews made the discovery some centuries ago, that "conduct conduces to happiness," and insisted upon it in their literature; and it further happened that upon Jewish literature the whole fabric of Christian theology was built up: but the truth and proof of the proposition is a matter of purely worldly wisdom, the outcome of experience, and has nothing whatever to do with theological dogmas. A. McD.

THE SENSES IN INFANTS.

[1162]—Having only just seen the series of four remarkable and highly interesting articles by "A. M. H. B." on Infant Psychology, in KNOWLEDGE, and accepting the invitation generally given to mothers to observe the development of their children, I should be glad to give a few facts connected with this subject which have come under my observation.

As regards the sense of smell, I noticed that my little girl was very susceptible, about the age of nine months, to the smell of oranges, frequently given her to play with, and would always sniff them before commencing to throw them about. When she was one year and four months, she was shown a pig-stye with pigs, and at once detected the bad smell; and always after, when spoken to about pigs, she would wrinkle her nose and make a wry face to show that a bad smell was connected with them. She early associated smell with flowers, but would smell a painted flower in the same way as a real one.

As regards the sense of colour, I found that the colour she noticed first was yellow, and at the age of three months she would always be appeased when crying if I took her to look at some large yellow brass plates which hung on the wall. She also, at the same age, particularly noticed a yellow silk handkerchief I used to wear, though taking no notice of a blue one.

The appreciation for music developed early. Before the age of three months she would be quite quiet when crying if I sang Tyrolese Jödlers to her (these songs have very high notes), and she would screw up her mouth and attempt to sing with me by making sounds like gu-gu (a faint imitation of the sound of a Jödler). At the age of eleven months she often pitched on the right note in attempting to sing with me. This delight in bright music with high notes continued for some time; but when, at the age of one year and three months, I sang a low song in the minor key she became very uneasy and began to cry. A few hours before I had sung quick, high music, and she laughed and was delighted with it. The piano, however, whether accompanied with or without a voice, always made her cry up to the age of one year and three months. Since then she has learnt to tolerate it, and within the last five months, if put near it, likes to play the piano. The value of A. M. H. B.'s articles is very great, and the readers of KNOWLEDGE ought to be much indebted to it for publishing such interesting, and yet popular, science, for they not only teach mothers how to understand and what to observe in their children, but are also a contribution to the early history of the race. A MOTHER.

EFFECT PRODUCED BY GROWING A COLOURED HYACINTH IN DARKNESS.

[1163]—In October, 1882, I placed a bulb of Hyacinth in a pot of mould and allowed it to remain in the light until it showed signs of sprouting. It was then removed to a photographic tent, erected in a room. Light was perfectly excluded, but there was complete ventilation. In March, 1883, the bulb bore a stem of dark purple flowers. The leaves were *totally devoid of colour*. The main flower-stem and footstalk of the flowers were also totally colourless. The intensity and brilliancy of the colour in the flower could not, I think, have been exceeded, had they grown in daylight. The same bulb has flowered again this year (planted in Oct., 1883,) having been grown in the light. The cluster of flowers is not so large as that of last year, and the colour is not quite so deep.

JOHN STONE.

VEGETABLE DIET.

[1164]—Recently Mr. T. R. Allanson, in a paper entitled "Cheap and Good Food," broached a subject which, while being of the first importance to all mankind, is, owing to the peculiarities of their position, year by year forcing itself, with special and increased acuteness, on the attention of the rapidly-growing populations of these islands.

Mr. Allanson strongly recommends vegetarianism as the remedy for dear food, as well as for certain other evils. In support of his views he makes certain statements of facts. Presuming on the correctness of those statements, the question occurs, do they necessarily or conclusively support his views?

If it is granted that certain vegetables contain more nutriment, weight for weight, than meat does, is the problem, then, any nearer to its solution? Which is of the chief consideration, the amount of nutriment contained in a food, or the amount that may be extracted from it? Do we always make use of the whole quantity contained in any kind? Do the digestive organs of necessity extract the most nutriment, or extract it with the greatest ease, from a food which contains an exceptional amount? From reasons similar to those which render it necessary to dilute spirit with water, may not, in some cases, the addition of a quantity of non-nutritious matter be in reality a great advantage? Also, letting alone the question of proportional quantity, may not the non-nutritious matter, in some cases, assist the digestion of that which is nutritious?

In fact, is it not quite possible for a table, showing the percentages of nutriment, to be a completely fallacious guide as to the choice of food? Might not a food, ranking low in such scale, in reality supply more nutriment than some other food, ranking exceptionally high, would do?

Again, is a man bound to be either healthier or stronger the more he weighs? Is it absolutely demonstrated that the diseases mentioned by Mr. Allanson are caused or increased by the usual mixed flesh and vegetable diet, or that vegetarianism would not favour other diseases equally dangerous? Are the inhabitants of vegetarian countries healthier, physically stronger, or mentally superior to the inhabitants of those countries where meat forms a part of the diet?

Finally, as a matter of common experience, is not a man very likely to really feel better and stronger at a time when he is quite convinced that he is so? J. BINDON CARTER.

STRANGE FISH.

[1165]—Anent your correspondent Mr. John Hann's letter in a recent number of KNOWLEDGE, on "Strange Resuscitation" of a fish, perhaps the accompanying extract from *Daily News* of 21st ult.

may help; although the resuscitation of the frozen fish mentioned in it is by warm water, and not by being struck:

"An astounding fish—we had almost written 'fishy'—story comes from the Dominion of Canada. We have read of singing fish and of fish, not to speak of oysters, which climb up a tree and and go to roost like birds, and of the salmon which follows his master like a dog, but verily we have not heard or seen them. The majority of these stories come from the East, but the great West is not without ichthyological marvels. A winter fishery has recently been established at Birch Lake, 150 miles north of the Canada Pacific Railroad. The fishermen 'claim' to have caught with hook and line during the last month 250,000 pickerel, which have been distributed through the Middle and Eastern States of the Union, many of them getting as far as New York. These pickerel are said to be of finer flavour than those of southern waters. They are taken from the water alive and frozen in a few minutes. *'It is also said' that some of them will come to life if placed in a tank of cold water for a few hours to 'draw the frost out of them gradually.'* Now, if these animals had been snakes we should have hesitated to repeat the story. The serpent is not only the arch liar himself, but the cause of lies in others. To say that a tale is snaky is to hint a doubt at once. But the pickerel is not a reptile, but an honest fish, and of pleasant association, for is it not written that 'Hops and turkeys, pickerel and beer, Came into England all in one year?' Wherefore we merely echo the remark made by the Irish gentleman when a process-server crawled out of a pond into which he had been hurled after being beaten nearly to death with sticks, 'The tenacity of life among the lower animals is wonderful!'" MEDICUS.

[Before ridiculing the account, the *Daily News* writer might with advantage have studied what Dr. B. W. Richardson wrote on the subject of suspended animation a few years ago.—R. P.]

GHOSTLY VISITANTS.

[1166]—About four or five years ago, Mr. E. T. Smith, a well-known London impresario, died suddenly at his house at Kennington.

Knowing the old gentleman well, I called to condole with his young widow the second evening after his death. I found her and the two children and the maid servant in a very hysterical condition. They solemnly affirmed that, about an hour before, the corpse had knocked at the street door. The servant opened it, and instantly fainted. The widow heard her dead husband's voice most distinctly; so did the two children and a lady visitor, an old friend. The whole party were in a terrible state of nervous fright—quite unmistakable as to its reality. It appeared that the ghost had knocked, shown himself to the servant, said something, then vanished. All agreed on these points. I went upstairs alone, no one volunteering to accompany me. As I, of course, knew would be the case, there was the coffin with its contents intact. Evidently nothing had been disturbed since my old friend had been comfortably prepared for his long sleep.

I reported this fact to the family (the visitor had gone home), but this made no difference in their belief. The corpse certainly *had* knocked at the hall-door. The evidence of the wife, two children, the friend, and the servant, was not to be argued down by any theory that I could suggest, and I began at last almost to believe the story myself, so certain were they one and all.

As a ghost story, it was quite complete. No evidence could be possibly more truly given, or by more trustworthy persons. None of them were at all of a dreamy, imaginative, poetical temperament. On the contrary, every one was about as commonplace as a Cheshire cheese. Nevertheless all were genuinely in a very excited state. I suggested fetching their medical man, and was about going for him myself when there came a tap, tap, at the front door, which was recognised at once by Mrs. Smith as her late husband's old familiar knock. The maid came rushing into the room saying, "Oh, mum, there he is again! Whatever is to be done? I am sure I can't go and face it." Just then another solemn double tap was echoing through the house, which I undertook to answer.

It was about six o'clock on a misty autumnal evening, so, of course, quite dusk.

I opened the door, and sure enough there stood the dead man on the step, dressed about the same as I had seen him for years.

I didn't faint, but candidly admit that I wanted some brandy badly.

"Walk in, Mr. Smith," said I at last, fully prepared to believe in solid ghosts as long as I lived.

"Oh! I may come in now, may I?" said Mr. Smith. "When I was here last night you all seemed out of your senses, so I sloped. Pray, when do you bury my brother?"

This simple question at once explained the mystery.

The ghost was a twin brother, who had been out of England for some years. He was totally unknown to the widow, who, in fact, had never heard of his existence, the brothers having quarrelled and parted a long time ago. Having seen a notice of the death in the *Times*, he had resolved to attend the funeral as chief mourner. This he did, and every one was struck by his likeness to his late brother, both in voice and person.

Now, if the old gentleman (nearly so) had taken offence at what he might have considered the scurvy treatment received on his first visit, "sloped," as he called it, and never shown himself any more, what a perfect case of supernatural appearance would have been ready for record in the next edition of Mr. Crowe's "Night Side of Nature," or Mr. Newton Crosland's "Queer Spirit Book."

No doubt every unexplained ghost story has a twin brother in it if you could only find him. J. H. COBBETT.

GHOSTLY GARMENTS.

[1167]—The doubt which troubles you [Scarcely!—R. P.] as to ghostly vestments is one which apparently occurs to Spiritualists themselves. I find, in a report of a conference of Spiritualists, taken from the *Standard* of Aug. 7, 1874, that "Mr. Harrison stated that the materialised drapery of spirits was sometimes of a fabric not easily procurable in this country." "Mr. Rogers remarked that a piece of cloth cut off by a female spirit from her materialised skirt was found to have been dressed with lime in the Manchester fashion, and he admitted that this presented a difficulty to Spiritualists which had not yet been surmounted."

Surely these acute reasoners must since then have attained the solution of the question. L. M.

COINCIDENCE.

[1168]—The other day a party of about eight persons were discussing the merits of the late Mr. T. Todhunter, some praising him and others criticising him on his mathematical works; what brought Mr. Todhunter's name into the conversation no one knows; but it is a fact that when he was spoken of they all joined in the conversation that ensued. Nothing more happened; but a few days afterwards they heard that Mr. Todhunter had died about the time that they were talking of him. This is a striking coincidence, but it may be more than a coincidence—who knows? C. T. S.

LETTERS RECEIVED AND SHORT ANSWERS.

E. KEELAN.—J. NILSON.—No reward has been offered for squaring the circle. There would be no value in the solution of the problem, even were it possible—J. CAREY. Yes, if the well is deep enough, the opening small, and the star one of the brighter sort.—J. N. A. wishes to know the name of a good work on dyeing applied to leather, or, failing that, of a work on dyeing applied to cotton, silk, &c.—NEWTON CROSLAND. There is *no* opposing force. That is where you have been wrong from the outset—thanks to Joyce & Co. Hence no *tertium quid* is wanted. If your difficulties are to be fought out to the death, it must be with some other opponent.—A BEGINNER. (1) A string carried round from any point on the Arctic circle to the opposite point on the Antarctic circle (180° in longitude east or west of the former) and so back to the starting point, will give the great circle required. But it is better to use the wooden horizon circle. (2) You do not say what radius the cylinder is to have; if the radius is greater than that of the sphere there will be no intersection. If less, the intersection will lie on two equal small circles having the intersection of the axis of cylinder with the sphere as poles.—BIRKENBAUM. Fear we have no space for the suggested subject. Thanks, however.—STUDENT. Do not know where that method is given or established: what text-book is supposed to be used by those examined?—WM. POOLE. The sun's light and heat do not increase the earth's substance. Science does not recognise combustion as going on in the sun. Heat results rather from mechanical causes.—ED. WOOLLEY. I judge by what you tell me of Mr. H. Grattan Guinness that he knows nothing of astronomy. As to astrology, you are *bound* to meet with all manner of singular experiences, if only enough predictions are made, and you sift out those which are not fulfilled. I can predict—given enough trials—the winner of this year's Derby to a dead certainty. Yet I am no prophet.—T. RADMORE. Inserted. Thanks.—W. J. PAUL. Comet long since gone. That is Venus.—TYRO. Electricity might be obtained by utilising the heat of water applied to the junction of two metals, but the current produced by a temperature of 160° Fahr.

at one junction, and say 60° Fahr. at the other, would be too small to be commercially successful.—W. H. MOTTON. No wire or addressed envelope accompanies your request. Will, however, forward you an ohm length.—R. ELMORE. Many thanks. Will certainly take great interest in examining your picture.—W. GREATHEED. Many thanks; but the lines are not quite suitable to our columns.

Our Parador Column.

[We have been requested by the former secretary of the Zetetic Society to insert a series of papers in which he promises to show the nature of the deceptions practised by some at least among the advocates of the flat-earth theory.—ED.]

THE FLAT EARTH AND HER MOULDER.

BY H. OSSIPOFF WOOFSON.

I.

THERE is always a deep meaning concealed behind common sayings; and though generally of but few words, they often embrace a whole philosophy. By themselves they may express one thing, but if followed by another sentence, they will often embrace a whole moral teaching which, when applied to experience, strikingly illustrate facts of indisputable value.

My sojourn in England has been but of short duration, yet I have managed to learn much; and in the present case I have strictly, though unconsciously followed the advice of the Scotchman who maintained that "Honesty was the best policy" (in the negative, it would mean that dishonesty was the worst policy). Questioned as to how he knew it, his answer was "'Cause I've tried 'em both." As a matter of fact the adage and saying are bad from a moral point of view. Honesty should be a virtue, and not a necessity. But if we apply the whole to matters of investigation and of a speculative nature a better saying could scarcely be found. For it is by all means essential to *try both* sides of a question before we can say which is the right one. This I was led—quite inadvertently, I confess—to do, and it enabled me to investigate a teaching, which, for its audacity and ingenuity, hardly has an equal in the whole array of paradoxies and scientific frauds. Nay, not only was I led to investigate, but I was brought to regard it for a time as an accomplished fact, as a truth, persecuted and opposed by unscrupulous philosophers, whose object in resisting it was to postpone that punishment at the hands of universal judgment which would surely overtake them sooner or later.

Every falsehood must have a semblance of truth in it, and some plausibility, otherwise it could not gain converts; and as long as you believe the expounder of it to be sincere, you are sure to credit his statements. Simple-minded, credulous, inexperienced people do not, as a rule, require great inducement. For them a small amount of ingenuity and plausibility is sufficient to gain their fancy and to excite their imagination. To gain the credulity of people of higher culture the expounder of a pseudo theory must of necessity possess in proportion greater skill. Such hypocrites, we are bound to admit, must possess no ordinary perception of human failings and a vast psychological discernment.

There are *quacks* for all classes, and to suit all tastes. There is the street quack, who makes a good living by the sale of water and bread pills, supposed to effect marvellous cures; there are the impostors who amass fortunes by their self-denying generosity to benefit humanity by means of a bottle of stuff, for which they condescendingly accept a goodly fee. There are traps for everybody, the highest and the lowest.

Experience and good lessons are, however, essential elements for our future guidance, and, if these are obtained in our early lives, they really recompensate us in the long run for our mistakes and light-mindedness.

Now circumstances have led me to embrace the so-called Zetetic Philosophy, and, although far from being very much elated at the short-lived honour, I yet feel a kind of recompensation by the fact that my experience may be of service to others. Mr. Proctor, to whom my thanks are due for his generous offer to allow space in his valuable journal for [my account of the Zetetic Philosophy, has, indeed, not missed an opportunity to expose its falsehood; but he could have been scarcely expected to strike at the root of it for want of such information which I was enabled to collect.

I propose giving a detailed history, in short weekly articles, of the whole of what I shall allow myself to call the humbug catchpenny philosophy, concocted by a man who styles himself Parallax, otherwise Rowbotham, alias Tryon, Goulden, Dr. Birley, &c.

Our Mathematical Column.

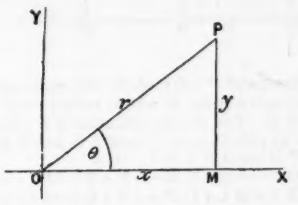
EASY LESSONS IN CO-ORDINATE GEOMETRY.

BY RICHARD A. PROCTOR.

(*Continued from p.* 173.)

TRANSFORMING CO-ORDINATES.

7. When the rectilinear co-ordinates of a point are given we can readily determine its polar co-ordinates, and *vice versâ*.



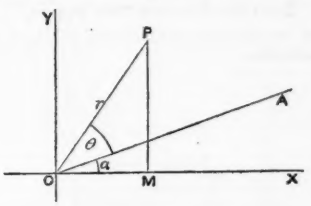
(i) Let the initial line coincide with O X, the axis of x, and the pole with O, the origin: Let P be a point in the plane; x, y, its rectilinear, and r, a, its polar co-ordinates. Join O P and draw P M perpendicular to O X; then, evidently

$$x = r\cos\theta, \quad \text{and } y = r\sin\theta$$

also $$r = \sqrt{x^2+y^2}, \text{ and } \tan\theta = \frac{y}{x}$$

Thus the rectilinear are expressed in terms of the polar co-ordinates, and *vice versâ*.

(ii) The pole O still coinciding with O, let the initial line O A,



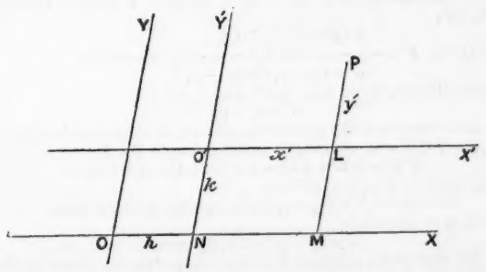
make with O X an angle a; then with the same construction, we have evidently

$$x = r\cos(\theta+a), \text{ and } y = r\sin(\theta+a)$$

also $$r = \sqrt{x^2+y^2}, \quad \text{and } \tan(\theta+a) = \frac{y}{x}$$

the required relations.

8. If the rectilinear co-ordinates of a point are given, the axes being oblique or rectangular, and, through a new origin, axes



parallel to the first are drawn, we can connect the co-ordinates of the point referred to the new axes, with the original co-ordinates.

Let the co-ordinates of P referred to the original axes O X, and O Y be x, y. Through the new origin O′ draw the axes O X′ and O Y′ parallel respectively to O X and O Y. Let the co-ordinates of O′ referred to O X and O Y be h, k; and the co-ordinates of P referred to O X′ and O Y′, x', y'. Draw P M parallel to O Y meeting O′ X′ in L and O X in M, and let O′ Y′ meet O X in N; then

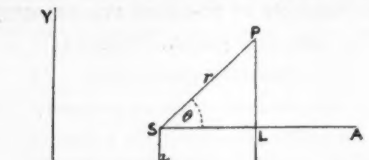
$$x = OM = ON + NM = ON + O'L = h + x'$$

and $$y = MP = ML + LP = O'N + LP = k + y'$$

the required relations.

9. If the rectilinear co-ordinates of a point are given, the axes being rectangular, and through a given point a straight line is

drawn parallel to the axis of x, we can connect the co-ordinates of the point referred to the given point as pole and the line drawn through that point as initial line, with the original co-ordinates.



Let the co-ordinates of P referred to the rectangular axes O X, O Y be x y. Through a point S whose co-ordinates are h, k, draw S A parallel to O X. Let the co-ordinates of P referred to S A as initial line and S as pole be r, θ. Draw S N and P M perpendicular to O X, and let P M meet S A in L; then

$$x = O M = O N + N M = O N + S L = h + r \cos\theta$$

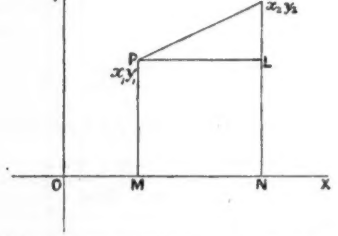
and $$Y = M P = M L + L P = S N + L P = k + r \sin\theta$$

the required relations.

Arts. 7, 8, 9 are instances of what is called transformation of co-ordinates. We shall return to the consideration of transformation of co-ordinates later on. For our present purposes the foregoing articles will prove more than sufficient. We may remark that they enable us to transform from one set of rectangular axes to *any* other in the same plane. For Article 9 enables us to proceed from rectangular axes to a polar system having *any* pole, but the initial line parallel to O X; and Article 8 enables us to proceed from this system to *any* rectangular axes having the pole of that system for origin.

DISTANCE BETWEEN TWO POINTS.

10. *To express the distance between two points, in terms of their rectilinear co-ordinates.*



Let P and Q be the two points; x_1, y_1 the co-ordinates of P, and x_2, y_2 those of Q. Draw P M, and Q N parallel to O Y to meet O X, and P L parallel to O X to meet Q N. Let P Q $= d$. Then, by Euc. I., 47;

$$P Q^2 = P L^2 + L Q^2.$$

But P Q $= d$, P L $= x_2 - x_1$, and Q L $= y_2 - y_1$; therefore

$$d^2 = (x_2 - x_1)^2 + (y_2 - y_1)^2.$$

If P is at the origin, so that $x_1 = 0$, and $y_1 = 0$

$$d^2 = x_2^2 + y_2^2$$

We have supposed the axes rectangular; if they are oblique, and the angle Y O X $= \omega$, we get, from the triangle P L Q

$$P Q^2 = P L^2 + L Q^2 - 2\, P L \,.\, L Q \cos P L Q$$

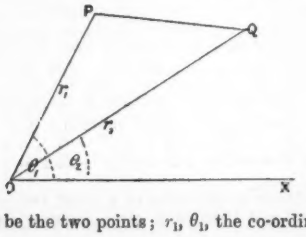
that is, since $\angle$ P L Q $= 180° - \omega$

$$d^2 = (x_2 - x_1)^2 + (y_2 - y_1)^2 + 2\,(x_2 - x_1)\,(y_2 - y_1)\cos\omega$$

and if P is at the origin

$$d^2 = x_2^2 + y_2^2 + 2\, x_2\, y_2 \cos\omega.$$

11. *To express the distance between two points in terms of their polar co-ordinates.*



Let P and Q be the two points; r_1, θ_1, the co-ordinates of P, and r_2, θ_2, those of Q. Join P Q, and let P Q $= d$; then,

$$P Q^2 = P O^2 + O Q^2 - 2\, P O \,.\, O Q \cos P O Q$$

that is

$$d^2 = r_1^2 + r_2^2 - 2 r_1 r_2 \cos(\theta_1 - \theta_2)$$

We might have deduced this result from Art. 10 as follows:—

The rectilinear co-ordinates of the points P and Q referred to O X as axis of x, and a perpendicular to O X through O as axis of y are respectively $r_1 \cos\theta_1$, $r_1 \sin\theta_1$, and $r_2 \cos\theta_2$, $r_2 \sin\theta_2$, Art. 7. Hence by Art. 10

$$d^2 = (r_1 \cos\theta_1 - r_2 \cos\theta_2)^2 + (r_1 \sin\theta_1 - r_2 \sin\theta_2)^2$$
$$= r_1^2 + r_2^2 - 2 r_1 r_2 \cos(\theta_1 - \theta_2)$$

(To be continued.)

EASY RIDERS ON EUCLID'S FIRST BOOK,

WITH OCCASIONAL SUGGESTIONS.

PROP. 8.

23. The diagonals of a rhombus intersect each other at right angles.

24. A quadrilateral has two of its opposite sides equal, and its diagonals are also equal. Show that the diagonals divide the quadrilateral into four triangles whereof two are isosceles and the other two equal to each other in all respects.

25. From every point of a given line the lines drawn to each of two given points on opposite sides of the line are equal. Prove that the line joining the given points will be bisected by the given line at right angles.

26. Show how Prop. 8 may be established without the use of Prop. 7, by applying the base of one triangle to the base of the other, the equal sides being conterminous but the vertices lying on opposite sides of the base.

Join the vertices; the rest is obvious.

PROP. 9.

27. If the base angles of an isosceles triangle be bisected, and the point of intersection of the bisectors joined to the vertex of the triangle, show that the vertical angle is bisected by the line thus drawn.

PROP. 10.

28. Show how to bisect a given straight line without making use of any proposition beyond the Sixth.

See fourth rider to Prop. 6.

PROP. 11.

29. Show how to draw a straight line at right angles to a given straight line from a given point in the same without making use of any proposition beyond the Sixth.

30. Find a point in a given line such that its distances from two given points may be equal.

31. Describe a circle of given radius to pass through two given points.

(To be continued).

THE sixth edition of Mr. Thomas Smith's handy manual entitled "Successful Advertising" has just reached us. It is neatly got-up, and concisely presents a great deal of real information, not only to inexperienced advertisers, but also to those who, while knowing the "tricks of the trade" and being well able to take care of their own interests, yet have not time to elicit such information for themselves. As Macaulay has truly observed, "Advertising is to business what steam is to commerce—the grand propelling power"; and those who desire to turn that power to the best account are recommended to peruse the little book in question.

THE Director of Public Gardens in Jamaica reports the existence in St. Helena of large quantities of black oxide of manganese, or pyrosulite, samples of which have been analysed by Professor Roscoe, with the result that one sample of St. Helena manganese, soft, found in clay beds, yielded 35·41 per cent. of manganese di-oxide; while a second sample, hard, found in clinker, yielded as much as 63·19 per cent. of manganese di-oxide. This recalls the fact that large quantities of this material exist in Jamaica, samples of which, analysed by Dr. Lewis Hoffmann for the Geological Survey of Jamaica, show 88·89, or practically 90 per cent. of manganese di-oxide.

Our Chess Column.

By MEPHISTO.

PROBLEM No. 115.

IT is very gratifying for us to find that this Problem has given general satisfaction. The competition has been a very keen one. An unforeseen difficulty arose in connection with it: we received some solutions dated London, the 20th, but also some from the country that must have been posted a few hours later only. Giving our country cousins an allowance of time and the benefit of the doubt, we have decided to award the Prize to MISS ASHWORTH, of Brighton. We shall give the solution next week.

Correct solutions received from:—C. H. Brockelbank, W., S. B. B., E. Louden, S. Lawther, H. B. J., E. Stevens, Edward Carter, Wm. Fazan, J. A. Miles, A. W. Overton, E. Waller, J. E. Hull, E. Hamburger, W. Powell, J. Alfred Hill, H. Humphrys, W. Ratcliff, G. Woodcock, Berrow, Fell, L. F., Thos. Carroll, F. L. d'Anson, H. H. Shanks, J. H. Meredith, Edward Ridgway, Uncle John, W. H. S. Monck, A. Rutherford, A. W. Orr, A. McD., A. Smith, H. A. L. S., E. C. H., John Watson, A. Schmucke, W. Kemsley, A. J. Argles, F. J. D., G. Robson, R. McKay, Watkins Calvert.

Incorrect solutions:—Edwin Butler, M. A., J. P. Harrap, W. H. Percy, T. D., R. Dutton, A. M. Holland, K. W., K. W. Johnson, Dr. Highett, J. W. Ellitt, A. Mooney, Clarence Becker, H. H. Shanks, Senex, Thomas K. Bentley, Thos. P. Burton, Bonnward, Geo. Smith, W. J. Peek, The Owl (M.D), J. Winfield, A. S. Orr, J. Griffith, Lawrence Small, Dr. Healy, J. H.

We also thank our numerous correspondents for the good wishes expressed towards us.

A SINGULAR ENDING.

THE following position occurred a few days since in a game in which Mr. Proctor had given the Queen to a young amateur. It was White's move, and certainly the position at a first view does

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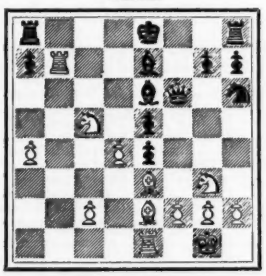

WHITE.

not suggest even the possibility of so rapid a clearing off as actually followed. The game proceeded thus:—

White. Mr. Proctor.	Black. Young Amateur.	White. Mr. Proctor.	Black. Young Amateur.
1. R tks B (ch)	Q takes R(*a*)	7. R takes Q	R to QB sq
3. B takes Kt	P takes B	8. R to Q4 (ch) (*e*)	K to QB2
3. Kt takes B	Q takes Kt	9. R to QB4 (ch)	K to Q sq
4. P takes P	Q takes P (*b*)	10. R takes R	K takes R
5. Kt tks P (*c*)	Q takes Kt (*d*)	11. P to Kt3	
6. B to Kt5 (ch)	K to Q sq		

And White won easily.

(*a*) White's move was unsound. K takes B was the better reply, but the move in the text was safe enough.

(*b*) White's fourth move was unsound, but played with the assurance that Black would snap at the Pawn.

(*c*) Up to this point it has been a case of *nothing venture nothing win*.

(*d*) The proffer of Knight for Pawn should have shown there was a trap. Black's game was still perfectly safe.

(*e*) Not a piece is now left on the King's file, which at starting had not shown a vacant square!

THE following interesting game was played some time ago at Parsell's Rooms. It may be said to demonstrate the unreliable nature of the Scotch Gambit attack. We say this without any intention of depreciating the opening, but so much is sure that with average play the first player will often find that he has not retained a perfect command over his forces, although he has apparently an attacking position. This is particularly the case where P to KB4 has been played, which will often result in White, after having Castled, having his B on K3 and Kt on Q4, blocked in an inconvenient manner by the Black B on QB4:—

SCOTCH GAMBIT.

White. Mr. E. N. F.	Black. Mephisto.	White. Mr. E. N. F.	Black. Mephisto.
1. P to K4	P to K4	18. Kt to B3	P × P
2. Kt to KB3	Kt to QB3	19. Kt × P	P to R5
3. P to Q4	P × P	20. P to Kt5 (*c*)	Kt to B4
4. Kt × P	B to B4	21. B to KB4	Kt to Kt6 (ch) (*d*)
5. B to K3	Q to B3		
6. P to QB3	KKt to K2	22. K to Kt sq	Kt × Kt
7. B to QB4	Q to Kt3	23. P × Kt	Q × P
8. Castles	Kt to K4 (*a*)	24. P to Kt6 (*e*)	P to R3
9. B to Q3	P to Q3 (*b*)	25. P × P	K × P
10. P to B3	B to KR6	26. R to B sq (ch)	K to Kt sq
11. R to B2	Castles QR	27. B × RP (*f*)	B to B3 (*g*)
12. K to R sq	B to Q2	28. Q to Kt3	KR to B sq (*h*)
13. B to KB sq	P to KR4	29. B × KtP	B × B
14. P to QKt4	B to Kt3	30. P to R6	P to Kt4 (?)
15. P to QR4	P to KB4	31. R to K2 (*i*)	Q × P (ch) (*j*)
16. P to R5	B × Kt	32. B to K3	Q to Q4
17. P × B	Kt to B2	33. Q to Kt5	Resigns

NOTES.

(*a*) Q × P would be dangerous.

(*b*) Not so good as P to Q4, which would result in 10. P to B3, Kt × B. 11. Q × Kt, P × P, and White would remain with an isolated Pawn.

(*c*) So far the game has resulted in a slight advantage in Black's position, who disregards any possible danger from the advance of White's Pawns.

(*d*) This wins a Pawn, as White dare not take the Kt, for after P × Kt, P × P, discovering check; for that reason Kt or B × Kt would also not hold good, as after the Black Pawn had taken, the White RP would remain pinned by the Black Rook.

(*e*) A very attacking move. From this point White rapidly recovers lost ground by ingenious play. We give a diagram of the position.

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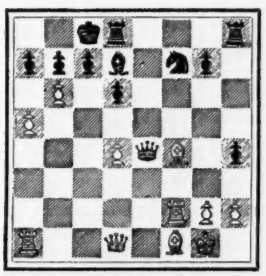


WHITE.

Position after White's 24th move.

(*f*) Very well played.

(*g*) It would seem better play to capture the B, when the following might have resulted:—27. P × B. 28. Q to Kt3 (ch), B to Kt4. 29. Q × Kt, R to Q2. 30. B × P (ch), K to R sq. 31. Q to B4, and the game would probably result in a draw.

(*h*) This was very weak. R to Q2 would have been better.

(*i*) The climax of a series of brilliant moves. White we think would now win in any case, but B to K3 appears to be stronger.

(*j*) An interesting continuation would have been if the Black Queen had, instead of capturing the Pawn, played Q to Q4; then follows 32. Q × B (ch), Q × Q. 33. P × Q. Black could not now play P × B on account of 34. R to R2; but R to Q2 would have equalised matters.

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

An Inquirer.—Cook's "Synopsis" is out of print.

KNOWLEDGE, Nos. 62 and 63 wanted. 4d. each will be paid.—Apply to the PUBLISHERS, 75, Great Queen-street, London, W.C.

Our Whist Column.

By "Five of Clubs."

ILLUSTRATIVE GAME BY MR. LEWIS.

The Hands.

B { *Spades*—10, 7, 2. Hearts—10, 9, 3. Clubs—A, 7, 5, 4. Diamonds—Q, 10, 5. }

Y { *Spades*—8, 6. Hearts—Q, 4. Clubs—K, Q, 10, 9, 2. Dia.—K, 7, 6, 2. }

A B, 3. B

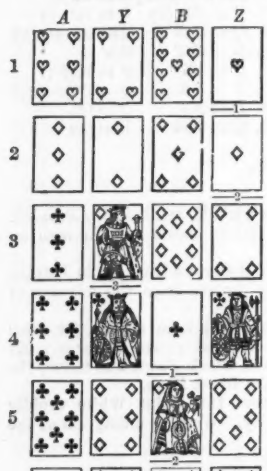
Y — Dealer. Z

YZ, 3. — *Trump.* — *S.* K.

Leader. A

Z { 4, 5, Q, K—*Spades*. 2, 8, A—Hearts. Kn—Clubs. 4, 8, 9, Kn, A—Dia. }

A { *Spades*—A, Kn, 9, 3. Hearts—K, Kn, 7, 6, 5. Clubs—8, 6, 3. Diamonds—3. }



NOTES AND INFERENCES.

By Mr. Lewis.

1. *A* leads the penultimate.

3. *A* properly discards a Club, having ample strength in trumps.

4. The fall of the Ten in the previous trick leaves *B* with either Knave or Queen. *Y* opens his strong suit of Clubs.

5. *B* gives his partner another discard.

6. The lead of trump through the honour is here forced. *Z* having four trumps passes, but he ought to have played the Q, so as to get the lead on the second round.

7. *B* continues; the fall of the cards shows *A* that the small trump is with *B*.

8. *A* now knows that he must continue his suit of Hearts. If he draws the third round of trump he is immediately forced, and leaves the long trump with *Z*, to enable him to bring in his D. The fall of the H Q enables *A* to see his way to the game, which now plays itself, but it is a curious fact that the penultimate of the original lead is, legitimately, the last card, and the winning one.

Note by "Five of Clubs."

The game is the more interesting that the hands are so well matched. The strength of *A-B*, however, is divided, while *Y-Z*'s lies nearly all in *Z*'s hands. Thus I think *Z* would have done well to lead trumps at trick 2, trusting to get some help from his partner. The game would then have opened as follows:—

	A	*Y*	*B*	*Z*
1.	H 6	H 4	H 9	H A
2.	S 3	S 8	S 10	S 4
3.	H K	H Q	H 10	H 2 (a)
or 3.	C 6	C Q	C 4	C Kn (b)
or 3.	S A	S 6	S 2	S Q (c)

In case (a) it is obvious that *A* would be at a disadvantage. He would not force *Y*, the weak trump hand; he could not know that a lead of Ace Spade would draw *Y*'s last trump and leave him, *A*, free to force *Z*, and he would have no means of determining which of the other suits would turn out the best lead. In case (b), *Y* would lead Spade 6, and the cards falling would be those shown for trick 3, case (c), *A* still being in doubt whether *Y* held another Spade or not, after the Heart King had drawn *Y*'s Queen. If after 3 (b) followed by 3 (c) as fourth trick and 3 (a) as fifth, *A* ventured to play a forcing card, trusting to find *Y* without trumps, the round would end favourably for *A-B*, but they would make but the odd trick. If, on the other hand, *A* preferred, as he probably would, to return his partner a Club at trick 6, and *Z* passed the Ace, the seventh trick would fall to *Y*'s Club King. At the eighth, *A* would be forced with Club Ten, and the remaining tricks would fall to *Y-Z*, being won by S Four, S King, D Ace, D King, and C Nine. Lastly in case (c), which, considering the trump card, would be the best (though the boldest) play for *B*, *A* would lead Heart King at trick four, which would fall as 3 (a) above. He would then, knowing *Y* had no more Spades (for trick two shows he cannot hold the Seven), have forced *Z*, and so have given to the game the same aspect as in the actual play.

Answers to Correspondents.

J. D. Brown, Ealing.—You are quite right. In the Whist hand last week *Y* would have done well in discarding Diamond Ace, to show he had (probably) complete command of the suit. Yet, as his own suit was so very strong, he really had no occasion to retain the Spade to return his partner's lead. He was certain of his own Diamonds, but not of his partner's Spades.

S. R. W.—I think Clay meant rather that there is no more fatal—*i.e.*, foolish—habit at Whist than that of discontinuing a strong suit *merely* because you find it will be trumped. Certainly it is a risky experiment to go on when you are uncertain how the trumps lie. Only you have to remember that one of your opponents is likely enough to lead it, if it suits his game, and that you may thus gain little by changing your suit. If you are quite in doubt as to the other suits, you run a greater risk of playing your opponents' game by opening a weak suit, than by going on with your own. For after all, even though you are ruffed by the weak trump hand, you have advanced the clearing of your own suit, which, if your partner has strength in trumps, will tell in the long run.

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MR. R. A. PROCTOR'S COURSE OF LECTURES.

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The following arrangements are complete: the numbers in brackets referring to above list.

LONDON (Brixton Hall) March 28, April 1, 4, 8 (1, 2, 3, 4).
" (Memorial Hall), March 31, April 3 (1, 2, 3, 4).
CRYSTAL PALACE, April 7, 9 (1, 3).
ST. LEONARDS, March 29 (Afternoon); April 2 (Afternoon and Evening).
BIRMINGHAM (Town Hall), April 18, 23, 25, 28; May 2 (1, 2, 3, 5, 6).
LEAMINGTON (Royal Music Hall), Four Afternoons, April 17, 19, 24, 26 (1, 3, 5, 6); Two Evenings, April 17, 24 (2, 4).
St. HELEN'S (Lanc.), April 22 (2).
COVENTRY, April 30, May 1 (1, 2).
MALVERN, May 3, 17 (Afternoon) (2, 3).
LLANELLY, May 5 (1).
SWANSEA, May 6, 7 (1, 2).
WORCESTER, May 8, 9, 15, 16.
BANBURY, May 14 (Afternoon and Evening).
OXFORD, May 12, 13, 19, 20.
CAMBRIDGE, May 21, 22, 23.

Note.—*All communications respecting Lectures should be addressed to Mr. John Stuart, Royal Concert Hall, St. Leonards.*